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THE ENGINEERING SOCIETIES BUILDING.

Just 22 years ago according to its proceedings of 1885, the American Institute of Electrical Engineers was actively associated in a movement to secure a united engineering building. Never abandoned, after frequent failures, and having been brought to the notice of Mr. Carnegie in 1895, the idea had to await for its real fruition the memorable Institute Library dinner of 1903. This week has seen the dedication of a splendid and stately home for engineering bodies, the gift of Mr. Carnegie, which more than fills out the hopes and visions of at least a quarter of a century. It is distinctly a great event in engineering, a great endowment for future usefulness and public service.

The exercises and social functions associated with the affair were all quiet and in the best taste, pitched at first in a sober and almost religious key, and then as they advanced broadening and lightening in their effects, so as to bring out the human not less than the technical side of engineering. A noble enterprise has thus been smoothly launched, but it will be many years before the full opportunities of the building and its various departments can be adequately employed. Here will lie for the juniors the responsibility that the pioneers and elders in the engineering societies hand over to them. There is not the slightest doubt as to the beneficial fructification of all that has now been done. God speed the day and the work!

MEASUREMENT OF WIRE AND CABLE INSULATION.

In our issue of March 23, 1907, Mr. F. Wachter contributed an article on the measurment of wire and cable insulation, in which he advanced certain new and remarkable propositions as to the apparent linear insulation resistance of insulated wires when tested in different short lengths. We criticized the propositions at the time and challenged the conclusions that appeared to be drawn from the observations reported. Mr. Wachter's deductions may not be supported, but his reported observations at least have been useful in agitating the question, and in eliciting the views of others experienced in this line of technical work. We owe to these reported observations the excellent article on the subject appearing this week on page 795 by Mr. Tracy D. Waring. The article this week is valuable as giving a brief summary of the sources of error met with in the measurement of cable insulation resistances under factory conditions. Several useful expedients, such as the guard-ring expedient, are suggested, which should be widely known. We are glad to see that Mr. Waring has the courage to advocate openly the correct terminology of the megohm-mile instead of the meghom-per mile as the unit of linear insulation resistance. We agree with him that it is worth while endeavoring

to speak and write in accurate units. Much error has been disseminated by the loose selection of terms, such as "watt-meter" for a "watt-hour-meter."

Cyclic Temperature Changes in Lamp Filaments.

An interesting discussion of the causes and effects of cyclic temperature changes in incandescent lamp filaments, is given in a recent paper by Dr. Sahulka, of Vienna, an abstract of which will be found in the Digest in this issue. The existence of such changes when alternating current is used has been known ever since the very beginning of electric lighting by incandescence, and the observation of the change in brilliancy of the filament throughout the electric cycle formed the object of many early experiments by physicists. The real novelty of the present experiments, on which the interest now centers, consists not so much in the information acquired as in the means by which the information has been gained. Instead of observing the brilliancy of the filament directly by means of a rotating disk containing a slit, as has frequently been done, Dr. Sahulka measures the instantaneous value of the resistance of the filament, and ascertains the instantaneous brilliancy indirectly by inference as to the temperature. Having observed the change in resistance point by point throughout a cycle, by the use of a synchronously driven contact device, and subsequently determined the illumination from the lamp at each corresponding resistance reproduced by heating the filament to the proper temperature with the direct current used in measuring the resistance, the author has been enabled to investigate the complete cyclic time-value curve of the brilliancy and its relation to the time-value curves of the alternating current and e. m. f. It will be noted that the method used by Dr. Sahulka is applicable only to such filaments as possess very pronounced resistance-temperature coefficients. When a sinusoidal e. m. f. is impressed upon a filament of this nature, the resultant current must be non-sinusoidal. It would seem, therefore, that although the current and e. m. f. pass through zero at the same instant and hence there is no time-phase displacement between them, yet the power factor is not unity, because the current consists of several component currents of different frequencies, only the fundamental of which represents power by its multiplication with the e. m. f.

Eddy Current Losses in Armature Teeth.

Although the fundamental laws concerning the eddy-current losses in laminated magnetic structures have been formulated for many years and much practical experience in the application of the formulas to stationary transformers has shown that the laws have been properly expressed, yet the results from the use of the formulas in connection with revolving machinery have not been satisfactory. So large have been the disagreements found between calculations and observations of the core losses in dynamo armatures, that, when designing such structures, resort is usually had to empirical estimations rather than to direct calculation from fundamental laws. It is evident, however, that formulas properly expressing the relation of phenomena in Nature are applicable wheresoever such phenomena exist, and that any lack of agreement between predeterminations and test results is to be attributed to incorrect use of such formulas.

In an article appearing in this issue, Mr. F. E. Meurer develops a method by which the core losses in dynamo-electric machinery may be determined with the aid of only a very small amount of empirical approximation. To just what extent such refinements are desirable in practice only the designer is able to determine. It is probable, however, that for relatively standard machines empirical methods will continue to be employed, but that for special or unusual types the most exact general formulas are greatly desirable. It would seem that a formula to be absolutely exact must take account of the losses in the pole faces. These losses are considerable when the air gap is small, and they are in no respect negligible even when the pole faces are well laminated. The portion of the losses attributable to eddy currents may be minimized by proper subdivision and insulation of the eddy current paths, but the hysteretic portion remains unaltered. The latter is occasioned by a limited range of flux variation, but the cyclic frequency is high and the loss correspondingly large. Since the power for overcoming these losses is supplied mechanically at the dynamo shaft, and hence they are not directly separable from the armature iron losses, it is not improbable that much of the discrepancy between calculations based solely on the variation of flux in the armature and the observed power required to drive the armature shaft may be ascribed to the pole-face losses.

The Election Theory of Matter and of Radiation.

Prior to the discovery that an atom of matter was a composite body, possessing a structure of some kind, it was nearly hopeless to account for the luminous spectrum of a highly heated substance with its numerous bright lines and bands. Now, however, that we believe that a chemical atom is not the smallest thing in the world, but that on the contrary, it has a "diameter" estimated as 100,000 times greater than the diameter of the electrons which compose it, various suggestions have been made as to the nature and cause of the lines in the luminous spectra of heated bodies. In the February number of the *Philosophical Magazine* is an article (abstracted in the Digest) by Prof. G. A. Schott on this subject. It deals with the conditions that may be involved in an atom of matter consisting of a microcosm, something like the planet Saturn on a lilliputian scale; namely, a central attracting mass called a positive nucleus and a single ring of separate electrons, all just alike, and each consisting of a minute negative electric charge. In this case, in place of the gravitational attractive force between Saturn's rings and the central body, we have an attractive force due to the attractive of opposite charges. It has been shown that such electron rings might be stable and that the chemical and physical properties of different atoms of matter might be accounted for by different numbers and groupings of such rings. The atoms of heavy metals like gold and uranium would have numerous large rings of many electrons in all, while the atoms of light substances like hydrogen and lithium would have relatively few rings and a smaller total number of component electrons. The oscillatory motions of a single ring are discussed in the paper, with the result that while such free oscillations are capable of producing spectrum lines,

yet the amount of energy that can be assumed as resident in the individual electrons could not give out a radiation of sufficient intensity to be visible in the spectrum. If, however, we assume that the inter-atomic energy of oscillation displayed in the spectrum of a heated body is jostle-energy, derived from collisions between atoms, we could readily account for the energy radiated in spectrum-lines, although the internal energy of atoms not violently jostled by heat might be quite inadequate for the purpose.

An Analysis of the Causes of Candle-Power Depreciation in Frosted Lamps.

About a year ago, Messrs. J. R. Cravath and V. R. Lansingh reported in our columns (issue of March 17, 1906) that the depreciation in the useful life of an acid-frosted incandescent lamp, was decidedly more rapid than that of a similar lamp with its globe clear or unfrosted. The causes for this shorter useful life of frosted lamps were not stated. A lamp which is frosted is much pleasanter to contemplate, or to read by, than a clear lamp of equal candle-power not enclosed in a globe or reflector, because the intrinsic brilliancy of the glowing filament viewed directly through the walls of a clear globe is something like 25 candles per sq. cm. of glowing surface, whereas when the lamp is frosted, the brilliancy is reduced to say, 0.1 candle per sq. cm. of bright globe surface. Although the total average illumination thrown on the pupil of the eye may be nearly the same in the two cases, yet the intensity of local stimulus to the retina will be much greater, and perhaps painfully great, with the clear globe, when the latter is viewed directly. It is a drawback to the frosted globe that its useful life-time, or service hours to 80 per cent of normal initial candle-power, is lower than that of an unfrosted globe, and considerable interest attaches to the cause of this unduly hastened senility.

The article by Mr. Preston S. Millar, appearing on page 789 of this number, discusses the nature of the causes which bring about the hasty depreciation of lighting with frosted incandescent lamps. Measurements were first made of the absorption of light in horizontal directions by "clear" globes of new lamps, 88 per cent lamps and 80 per cent lamps respectively, an 80 per cent lamp meaning a lamp whose mean horizontal candle-power had fallen to 80 per cent of the original normal by burning. It was found that a new "clear" globe absorbed 5 per cent of the transmitted horizontal intensity, 88 per cent globes 11.7 per cent and 80 per cent globes 15.7 per cent. This means incidentally that a "clear" lamp which falls to 80 per cent of its initial candle-power loses about 10 per cent by extra light absorption in the walls of the globe, and the remaining 10 per cent by changes in the filament. When a group of new, 88 per cent, and 80 per cent clear lamps were frosted, it was found that the spherical candle-power fell off 6 per cent, 14.3 per cent, and 18.9 per cent respectively. If this means that the mean horizontal candle-power fell off in like proportion—a matter that should be further investigated—then the total loss of internal mean horizontal candle-power in new, 88 per cent, and 80 per cent frosted lamps would be 10.6 per cent, 24.4 per cent and 31.8 per cent respectively, or somewhat more than twice the loss in corresponding clear lamps. The theory of the additional absorption of frosted walls is very easily outlined, but is very complex in full detail. If we consider an incandescent lamp as theoretically equivalent to a thin spherical clear glass globe with a luminous point source at the center, then if the coefficient of light transmission through the glass is denoted by a, which in practice would be a fraction lying say, between 0.84 and 0.95, and the point source emits one lumen of light, the total quantity of emerging and radiated light will be a lumens. Strictly speaking, account should be taken of reflection of light back into the globe at the inner and outer walls of the globe, but to a first approximation these complications may be ignored. If now the same globe be frosted, in such a manner that the frosting surface is a complete diffuser, each particle of the frosted external surface will act as a recipient of light from within, and as a secondary point source will emit this light equally in all directions. Half of the light reaching the external frosted layer will be thrown back again, or only $a/2$ lumens will be radiated away, and $a/2$ will go back through the walls, suffering absorption as they return. The light getting inside will be $a^2/2$ lumens. This will all cross the interior and pass out again to the opposite surface after undergoing absorption, and $a^3/2$ lumens will reach the frosted external layer on second emergence. Half of this will be radiated out, or $a^3/4$ lumens, the other half going back again into the globe. At each successive radiation the luminous emission will be diminished $a^2/2$ times.

If we sum up the total radiation stream due to first, second, third and finally infinite emissions, we find the total light emitted will be $a/(2-a^2)$ lumens for the frosted globe, as compared with a lumens for the same globe unfrosted, or the frosting has reduced the luminosity of the lamp in the reciprocal ration of $(2-a^2)$. If we apply this rough theory to the observations reported, the results agree reasonably well, but the observed candle-powers of the frosted lamps are distinctly higher than those obtained from the formula. Of course, we have a number of complications to influence the theory, such as the actual diffusing power of the frosted surface, the shape and opaque base of the lamp, etc. Nevertheless, the reported results of Mr. Millar, which deserve much commendation for the care and effort involved, appear to be substantially in agreement with the first approximation theory. It is pointed out in the article that external dirt materially affects the partial falling off in the luminosity of a frosted globe. If we wipe a clear lamp with a dry cloth, any deposit of dust without grease can be rubbed off, and the lamp is thereby cleansed. If, however, we wipe a frosted lamp with a dry cloth, dust may be rubbed in to the crevices of the roughened surface, and the lamp is not thereby cleansed to the same extent. More time and care is, therefore, necessary for the cleansing of frosted lamps, which means that, in practice, they are usually dirtier and more absorbent than similar unfrosted lamps. A prismatic globe enclosing a clear incandescent lamp absorbs more light than a new frosted surface, but not after carbon has deposited on the interior of the lamp globe as shown by Messrs. Cravath and Lansingh in the preceding article above referred to. A frosted globe is thus more luminous than a prismatic clear globe at the start, but the advantage transfers to the clear globe as time goes on, and moreover the holophane globe is easier to clean off than a frosted globe. Mr. Millar's article deserves careful notice from those who study illumination by incandescent lamps.

Dedication of the Engineering Societies Building.

Bedecked with flags and bunting, softened with palms and green bay trees, echoing to choice music, and crowded with all who are most conspicuous in the engineering world, as well as with hundreds of ladies, the stately Engineering Societies Building, on West Thirty-ninth Street, New York City, was dedicated with appropriate and dignified ceremonies on April 16. An account of the dedicatory exercises is given briefly below. Immediately after the main exercises, Mrs. Carnegie, in the presence of a few of the officers, unveiled the bronze bust of her husband, by Mrs. E. Cadwalader Guild, in the beautiful library. In the evening, a brilliant reception was held attended by over 2,500 people. The receiving line comprised Mr. and Mrs. E. E. Olcott; Dr. and Mrs. F. R. Hutton; Dr. and Mrs. S. Sheldon; Mr. and Mrs. J. W. Lieb, Jr. Music and refreshments were furnished, and until 1 a. m. the halls and rooms were crowded. During the evening each founder and affiliated society also received at its headquarters. The whole day passed off without the slightest hitch of any kind, and Mr. J. Lambden, the superintendent of the building, received many compliments on his efficient and effective preparations.

In the library a large number of choice and rare books, such as the gems of the Wheeler Collection, were shown, labelled, in glass cases. The designs were also on view of the Edison gold medal by Mr. J. E. Fraser and the "Commemorative" gold medal by Mr. Victor Brenner, the original of this to be presented to Mr. Carnegie.

The key used in the ceremonies of turning over the building from the architects and building committee to president Olcott, of the United Engineering Society as custodians was one of the Yale & Towne manufacture. The handle had been transformed, however, by a beautiful work of art contributed by Tiffany & Co. The gold chiefly employed was from the celebrated North Star Mine of Grass Valley, Cal., wrought into the laurel wreath and bearing the insignia of the Electrical, Mechanical & Mining Engineering Societies, while on the reverse, under a piece of polished rock crystal, were three particles of gold forming part of the original discovery of gold in California, having been washed in the tail race of the Marshall saw-mill by John Marshall himself on July 19, 1848. This gold has been carefully preserved by the U. S. Government and a little of it was presented to Dr. George F. Kuntz in recognition of professional service rendered the Government.

The official dedicatory exercises began on Tuesday afternoon at 3 o'clock and ended with a meeting on Wednesday at 2:30 p. m., a general reception having been held in the main auditorium of the building at 9 p. m. on Tuesday and receptions by the officers and councils of the Founder Societies in their respective headquarters at 10 p. m. on the same evening.

The opening address at the exercises on Tuesday afternoon was delivered by Mr. Charles Wallace Hunt as the presiding officer, who used as a gavel the setting maul employed by Mrs. Carnegie in laying the corner-stone of the building on May 8, 1906. This address was followed by a prayer by the Rev. Edward Everett Hale, after which communications were read from the President of the United States, the President of the Republic of Mexico and the Governor-General of Canada. The letter of President Roosevelt follows:

"I heartily congratulate you on the opening of the building of the Engineering Societies. The building will be the largest engineering center of its kind in the world. It is indeed the first of its kind, and its erection in New York serves to mark and emphasize the supremacy which this country is steadily achieving through her proficiency in applied science. The whole country is interested in the erection of such a building, and particularly, of course, all of those who follow either the profession of engineering or any kindred profession; and in no branch of work have Americans shown to greater advantage what we like to think of as the typically American characteristics."

Chairman Hunt then introduced Mr. Charles F. Scott, chairman of the Building Fund Committee. He referred to an address delivered by Mr. Scott in 1902 before the Engineers' Club of Philadelphia suggesting a general engineering headquarters, and gave details relating to the A. I. E. E. Library dinner in 1903, at which Mr. Carnegie was present, and where the several speakers spoke of the desirability of a building to contain the headquarters of the several engineering societies and a great engineering library. The following day Mr. Carnegie communicated with Mr. Calvin W. Rice asking him to call with a friend for a conference in relation to an engineering building. This conference was attended by Mr. Scott, then president of the A. I. E. E. and Mr. Rice, then a director of the same body.

Mr. Scott in opening his remarks gave details of the first meeting at which arrangements were made for a conference with officers of the American Institute of Electrical Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Society of Civil Engineers and the Engineers' Club of New York, at which meeting Mr. Carnegie made his offer of $1,000,000 for an engineering and a club building. Details were given of the organization of a conference body to have charge of all matters relating to the building. It was pointed out that since the date of the offer by Mr. Carnegie the three founder societies had increased 53 per cent in membership; in anticipation of the growing requirements of these bodies, the matter of a larger fund for the societies and the Engineers' Club was brought before Mr. Carnegie, who then increased his original offer to $1,500,000. Mr. Scott spoke of the great possibilities of the library, which had been embellished by the past-officers of the societies with a bust of the founder. The address of Mr. Scott concluded with an eloquent statement of the importance to modern development of engineering and the engineer, which is enhanced by co-operation, and the gift of Mr. Carnegie has already made the "harmonizing feature" an active force; the societies are working together, they are getting a broader view of their position and new inspiration for the larger work that lies before them.

The address of Acceptance of the Building was delivered by Mr. E. E. Olcott, president of the United Engineering Society, representing the Founder Societies. In introducing President Olcott, Chairman Hunt said in part: "This gift to engineering, which we now dedicate, is not only nor even principally the presentation to the Societies of this material building. Immeasurable benefits will also flow from the orienting of the minds and directing the energies of engineers into more effective co-operative work. We have an abiding faith that it is not engineers alone that will be benefited, but that the world itself is a better abode for man because of Mr. Carnegie's great donation."

The preliminary part of the programme having been disposed of, Mr. Andrew Carnegie was introduced. Chairman Hunt stated that at an early conference with Mr. Carnegie, the business in hand being disposed of, the members of the committee as they were preparing to leave were conversing with him on various subjects foreign to the occasion of their visit. Mr. Carnegie mentioned his lively interest in the project of erecting a modest memorial to James Watt. In closing he remarked: "I do not believe in spending large sums on monuments." Then turning a little aside from his guests he threw his left arm caressingly around an imaginary object, and pointing out to it said in a low, soliloquizing tone: "What I do believe in is something with a living soul in it." This chance remark deeply impressed his hearers, "something with a living soul in it" seemed to them more than a building, more than rooms without rental. In imagination they saw a grand engineering building. They saw this "living soul" developed into a patent world force constantly working as the centuries passed for the uplifting of everything in our civilization that depends on the life and the work of the engineer. To make this fleeting thought a reality and develop the idea into an ever living soul, the committee would have to undertake a task far greater than the erection of a building. It would be the erection of a building plus the embodyment of this vision. Unanimously the com-

mittee adopted this broad view and diligently bent its energies to work out the double task as the way opened. The committee has terminated its labors, and now presents this building as a worthy home for that living soul whose contemplation animated the mind of its donor and inspired the recipients of this great gift."

ADDRESS OF MR. CARNEGIE.

When Mr. Carnegie rose to speak, he asked the audience not to applaud him too long, lest he should conclude that they did not want to hear him.

"The Scotch have a saying," continued Mr. Carnegie, "and they have many wise sayings, that fools and bairns should never see a thing half done. I do not want to associate myself with fools and bairns, but I think I may add that donors should never see a thing half done.

"I went to Pittsburg the other day to see the completion of a task which I had placed in the making as far out of my personal observation as was this building. I saw a palace such as Aladdin might have brought forth and was overwhelmed. So to-day with this hall and this audience; and I am reminded of what Mrs. Carnegie said in Pittsburg when I likened it to the rubbing of Aladdin's lamp. She said: 'Yes, but we didn't even have to rub the lamp.'

"It is the spirit of the men that does the work; the safety of human society lies just here. Whenever we coalasce to do some good, a unification takes place and a consolidation; and whenever men meet to conspire against the public good—to do some evil—they find themselves unable to trust each other. That's why you needn't lie awake nights and worry about the future and about what problems society is going to meet. As sure as the sunflower turns toward the sun so the human race turns toward better things.

"This is the rock on which I rest, and on which I meditate sometimes. Nor can you deny this, that, quite apart from whatever evil exists, there is that principle of improvement inherent in us. To-day is better than yesterday and to-morrow will be better than to-day. So I look forward to the future of this building, and I know that the organizations to whom it is devoted will advance and continue to meet the developing needs of our age."

After Mr. Carnegie took his seat, Chairman Hunt introduced President Arthur T. Hadley, of Yale University, who had chosen for the topic of his address the subject, "The Professional Ideals of the Twentieth Century."

PRESIDENT HADLEY'S ADDRESS.

President Hadley stated that it is not the census figures which decide whether a nation is great or small. It is the industrial methods and educational ideals which these census figures indicate. He said, in part: "The men who did more than any others to make the Nineteenth Century different from other centuries that went before it were its engineers. Down to the close of the Eighteenth Century the thinking of the country was dominated by its theologists, its jurists and its physicians. It was reserved for the Nineteenth Century to recognize the dominance of abstract thought in a new field, the field of constructive effort, and to revere the trained scientific expert for what he had done in these lines. Engineering, which a hundred years ago was but a subordinate branch of the military art, has become in the years which have since elapsed a dominant factor in the intelligent practice of every art where power is to be applied with economy and intelligence. A building like this is therefore the symbol of all that is most distinctive in the thought of the century that has gone by.

"A hundred years ago there was a sharp separation between scientific theory and commercial practice. In those days when a man said he was practical it meant that he was not theoretical; that he did not know science, and didn't want to know it and didn't want to have any man around that did know it. The men of that day trusted to two guides, inherited prejudice and individual experience. The great element of progress in the Nineteenth Century has been the recognition on the part of mankind in general of the value of scientific generalizations in every department of human conduct. Of this change the engineer is the representative and the leader. He it is that makes physical science in its various lines applicable to the complex problems of construction and development. Not the building that you have built, gentlemen, nor the railroads that you have planned, nor the machines that you have invented, represent your greatest achievement. Yours is a proud boast of having in one brief century established science as the arbiter of the material force of mankind and of having enforced her worship upon a world once reluctant but now gloriously admiring.

"There are two quite distinct qualities which must be combined in order to secure the best professional services, two quite distinct tests which work must meet, in order to be pronounced first class. One of these is the technical standard, the other, for want of a better word, may be called the ethical standard. We have in the Nineteenth Century made so much progress in the technical training of doctors and lawyers and engineers that we sometimes forget that there is need of anything more than technical training. We have let the old idea of public leadership, which was prominent in the minds of the great professional men of past centuries, give place to another and narrower ideal which is fully satisfied when a man has made himself a technical expert. A man who believes that he is hired to carry out another man's ideas can never claim a position of actual leadership. He remains a paid servant—highly paid doubtless because he is possessed of a kind of skill which is very unusual, but nevertheless a servant bound to carry out the wishes of his master. It has been said that engineering is the hand-maiden of commerce, but I do not believe that the men who have planned and dedicated this building will be satisfied with any hand-maidenly conceptions of what their successors ought to be. For their own sake, and for the sake of the enduring quality of their work, we can appeal to the engineers and lawyers and physicists to see that it is adapted to public ends. If our engineers get their own minds clear, and get the public mind clear, as to the political economy of the properties entrusted to their charge and the ethics of their management, they can forestall those conflicts which now threaten to break out at any moment. If the engineer and the lawyer accept positions as servants, simply putting their technical knowledge at the disposal of merchant, journalist or politician who will pay the highest price for it, it is not simply a confession of inferiority, it is a dereliction of public duty.

"Let a man or group of men arise who had put their technical knowledge and readiness to use that knowledge in the public service, and people will be ready to put them in charge of affairs and follow where they lead. We have outgrown the day when a little common sense was sufficient for managing the affairs of the nation. They are become too complex, and this complexity gives the engineer, if he will add to his training in mathematics a training in ethics and political economy and the fundamental principles of the law, an opportunity such as never before existed to claim and receive the position which rightfully belongs to him."

During the exercises on Wednesday afternoon addresses were delivered by the Presidents of the Founder Societies, Dr. Samuel Sheldon, of the American Institute of Electrical Engineers; Dr. F. R. Hutton, of the American Society of Mechanical Engineers, and Dr. John Hays Hammond, of the American Institute of Mining Engineers, and by Mr. T. C. Martin, president of the Engineers' Club. An address was also delivered by Dr. James Douglas, past-president of the American Institute of Mining Engineers.

Mr. Charles F. Scott, Chairman of the John Fritz Medal Board of Award, presented to Professor Alexander Graham Bell the John Fritz gold medal. Commemorative medals for distinguished services were then presented by Dr. A. R. Ledoux, Past-president of the American Institute of Mining Engineers, representing the three Societies, to Ralph W. Pope, secretary of the American Institute of Electrical Engineers; F. R. Hutton, Past-secretary of the American Society of Mechanical Engineers, and Rossiter W. Raymond, Secretary of the American Institute of Mining Engineers.

Electricity at the Jamestown Exposition.

Electric power for the approaching exposition at Jamestown, like that at the Buffalo Pan-American Fair, will come from a distance. Having no Niagara to rely upon, however, power for the Jamestown Exposition will be furnished by steam turbines located in the power house of the Norfolk Railway & Light Company, about seven miles from the Exposition grounds. This fair will be the first at which the electrical energy will be generated by steam turbines. The machines will be of the Curtis type, these as well as the complete electrical equipment being supplied by the General Electric Company.

The exposition authorities have entered into a contract with the Norfolk Railway & Light Company to furnish all the electricity required for illumination and power purposes. The electricity generated at the Jamestown power house will be transmitted on specially constructed lines to a model sub-station in Machinery Hall. Here will be located the transforming and distributing apparatus. This equipment consists of large air-cooled transformers, many smaller transformers for general illumination as well as constant current transformers for the series-arc lighting system which will be used for police illumination. At the sub-station also are motor-generator sets to provide direct-current for the operation of searchlights and small motors where they may be installed by exhibitors.

The switchboard for controlling the various circuits throughout the exposition grounds is located in a gallery and is typical of modern switchboard engineering. All the electrical machinery follows standard lines similar to that installed at the St. Louis, the Pan-American and other American expositions.

Those who have seen the plans of the Jamestown Exposition predict that the electrical features, particularly the illumination, will equal if not excel the display at the famous Pan-American Exposition. Thousands of Edison incandescent lamps will be supplemented by searchlights, both on land and on the fleet anchored in Hampton Roads, combining to make the nightly pageant magnificent and beautiful.

Tungsten Lamp Patent.

A British patent has been issued to the Consortium fur Elektrochemische Industrie, of Nuremburg, Germany, on a process for making tungsten incandescent lamp filaments. The claims of the patent are on a process for producing incandescent bodies of tungsten, which consists in heating the said body almost to its melting point previous to its being employed in the lamp; and for producing incandescent filaments of tungsten, which consists in heating the said filament almost to its melting point by means of electricity before the filament is employed in the lamp.

In the specifications it is stated that the heating is effected by connecting up the filament to be treated in the same manner as an ordinary incandescent lamp filament, either in vacuo or in an indifferent gas, and heating the same to a very high degree by means of the electric current; or the filament may be heated in an electric arc generated between tungsten electrodes. The tungsten incandescent body to be employed subsequently in a lamp should, in the preliminary process, be heated to a degree corresponding to at least 1 watt per candle-power. This intensive heating will render the filament in a short time sufficiently constant for practical purposes for a consumption of from 1 to 1.5 watts per candle-power.

The advantageous effect which has been found to follow the intensive heating is stated to be probably due to the fact that the filament gives off all of its impurities in the high temperature and becomes denser; for example, after being thus heated it is noted that no slagging takes place, which have always been the case with tungsten filaments as hitherto made. It is stated that if an osmium filament is heated considerably above the usual temperature, it becomes so ductile that it can be easily rolled to a spiral without breaking, but at the same time its electrical resistance falls to a most extraordinary extent; on the other hand, the effect of heating on tungsten produces no alteration whatever in its physical properties.

Variable Speed Motors.

At the last meeting of the Electrical Committee of the National Board of Fire Underwriters, the following rule and explanatory notes on the subject of variable speed motors was adopted for Laboratory use and not as an addition to the Code, although it will be printed in the "List of Electrical Fittings" for information. The object is to get the two ratings called for and also suggestions as to classification.

All variable or varying speed, alternating current motors must be marked with the maximum current which they can safely carry for 5 minutes and 30 minutes respectively, starting cold.

Fine print notes:

Varying-speed motors are motors in which the speed varies automatically with the load, decreasing when the load increases, and *vice versa*. It does not mean motors in which the speed is varied by the use of different windings or groupings of windings, or motors in which the speed is varied by external means, and in which, after adjusting to a certain speed, the speed remains practically constant.

From these two "time and current" ratings the safe allowable current for any other length of time between 5 and 30 minutes can be determined by interpolation. The amount of current which a motor can safely carry for any given length of time is limited by the maximum allowable heating of the motor. This maximum temperature may be due to a certain current for a given *continuous* length of time, or may be reached as the result of different currents for various times, including periods of shut-down, during which the motor has a chance to cool somewhat.

Therefore, for any given set of conditions the final temperature is the same as that due to a certain current carried for a given length of time. Hence, for any particular service the problem for purposes of rating the motor is to estimate the time thus represented by the conditions, and from the 5-minute and 30-minute ratings of the motor in question to determine the current corresponding to this time. This current is then to be considered as the rated current, and the leads or branch wires selected as required under Rule 8, *b*.

The following classification of the more common services will serve as a guide in determining the "time" represented by any given condition:

Five-minute class:
- *a*. Operating valves.
- *b*. Raising or lowering rolls, tool heads, etc.

Ten-minute class:
- *a*. Hoists.
- *b*. Rolls.
- *c*. Ore and coal-handling machines.

Fifteen-minute class:
- *a*. Freight elevators.
- *b*. Shop cranes.

Twenty-minute class:
- *a*. Passenger elevators.

Thirty-minute class:
- *a*. Rolling tables.
- *b*. Pumps.

For example, according to the above classification a motor operating a shop crane would be considered to come in the 15-minute class, and if it had a 5-minute and 30-minute rating of 110 amperes and 50 amperes, respectively, the rating for this particular service would be 86 amperes. Add to this the 25 per cent required in Rule 8, *b*, giving 107 amperes, which according to the table of safe carrying capacity, Rule 16, would require No. 1 wire if rubber covered, or No. 3 wire if of other insulations.

Sudden Death of Gen. Eugene Griffin.

It is with deep regret that we note the sad fact that Gen. Eugene Griffin, first vice-president of the General Electric Company, died shortly after 1 o'clock a. m. on April 11 at his apartments in the Mohawk Club, Schenectady. Death resulted from apoplexy. Mrs. Griffin and daughter, Miss Priscilla Griffin, had come up from New York April 10 to attend the seventh annual performance of the Jest and Song Club, a local amateur minstrel organization of which Gen. Griffin's son, Hancock Griffin, is a prominent member and who the previous evening appeared as the floor walker in a local musical extravaganza presented by the club. After the theatre Gen. Griffin and a party of friends had luncheon at the Mohawk Club. It was while at the table chatting with Mr. and Mrs. S. Hamill, Mr. Oudin and members of his family that he was stricken with apoplexy. He died an hour and a half later, after having been carried to his apartments in the club.

Gen. Eugene Griffin was born in Ellsworth, Me., on October 13, 1855, and was graduated from West Point in the class of 1875, immediately becoming a Second Lieutenant in the Engineer Corps of the Regular army. In the fourteen years

GEN. EUGENE GRIFFIN.

which followed he rose to the rank of Captain of the corps. While on Governors Island in April, 1879, he married Miss Allie Hancock, a niece and adopted daughter of the late Gen. Winfield Scott Hancock. In the following October he resigned his post to engage in business. The outbreak of the Spanish-American war, however, called him again to service in the army, ranking first as Colonel in the First Regiment, United States Volunteer Engineers, which he organized and with which he served in Porto Rico during 1898 and 1899. On January 21, 1899, he was made a Brigadier-General of volunteers.

Soon after writing the first American Governmental report on electric railways and as the result of his observations while a prominent member of the engineering staff of the District of Columbia, Gen. Griffin became connected with the Thomson-Houston Electric Company, and later with the British Thomson-Houston Company. He became an expert electrical engineer, and may be said to have witnessed and directed the whole electric railway development of the old Thomson-Houston Company and later of the General Electric Company. He contributed some interesting reminiscences to these pages in 1904, giving details of his experience back to 1887. His brother-in-law, Mr. W. E. Baker, a well-known electrical engineer, was actively engaged with him in the same field through many years.

General Griffin was a member of the Union, University, Army and Navy and Engineers' clubs, as well as many other social organizations. At the time of his death he was a member of the board of trustees of the Engineers' Club. He was also a full member of the American Institute of Electrical Engineers, and an active member of its Land and Building Fund Committee, in whose work he took a deep interest.

The body was brought from Schenectady, and the funeral services were held on Saturday, April 13, at the Little Church Around the Corner, New York City. After the choral services at the church, the family and friends, numbering about sixty, accompanied the casket to West Point on a special train. A detail of artillery took charge of the casket, transporting it on a caisson to the chapel of the Military Academy, at which point the full corps of cadets formed as an escort. As the party started for the cemetery a salute of eleven minute guns was fired. At the cemetery the full military honors due a brigadier-general were observed; the customary three volleys of musketry being fired over the grave followed by eleven guns, after which taps completed the impressive ceremony.

Col. H. L. Scott, the superintendent of the Military Academy, was a class-mate of General Griffin at West Point. The following were the pallbearers: C. A. Coffin, president General Electric Company; Col. H. L. Scott, superintendent West Point Military Academy; Hinsdill Patsons, fourth vice-president General Electric Company; Col. H. F. Hodges, Major of Engineers, Washington; B. E. Sunny, Western manager General Electric Company; S. N. Hamill, Schenectady; H. R. Bishop and Dr. Louis Seaman, New York. Dr. Goodwin, who officiated during the latter part of the services at the church in New York, is the clergyman who married the General and Mrs. Griffin twenty-eight years ago.

Improvement in Quadruplex Telegraphy.

Direct-current dynamos are usually employed for the generation of power for the operation of telegraph circuits, including duplexed and quadruplexed lines. For many reasons it would be advantageous to utilize alternating currents for quadruplex work, but difficulties have been encountered in this direction that are absent when using direct currents. In the endeavor to adapt alternating currents to multiplex telegraphy, the problem has been to avoid interference and mutilation of signals, when more than one circuit is supplied by one machine and the instruments of different circuits are working simultaneously. Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, has been granted a patent on a method of operating as many circuits as may be convenient from one machine, without any interference between them. He uses as many commutating rings on the armature shaft as there are circuits to be operated. Each ring is divided into conductive and non-conductive sections, two of each. The two conductive arcs are connected electrically, while the non-conductive arcs are dead. The brushes are so disposed in their relations to the insulated and conductive sections of the rings that one collects the positive currents and the other the negative. The positive current is used in operating one side of the quadruplex and the negative the other side, the corresponding receiving relays being so wound that one responds only to positive currents and the other to negative. When two or more circuits are connected to one machine the commutating rings are so arranged on the shaft that no two circuits receive current pulsations at the same instant—that is, the positive pulsations, for instance, do not begin and end simultaneously. The lag is sufficient to allow a pulsation on one circuit to die out before the pulsation of the same sign passes into another circuit. Thus the pulsations of each sign follow one another in such rapid succession that even a dot of the Morse code will include enough of the corresponding positive or negative pulsation to cause the operation of the corresponding polarized relay at the distant station without a break. It is evident from this that the pulsations go to the different circuits at different instants, and in consequence there can be no interference between the circuits.

New Ohio Power Station Destroyed by Wind Storm.

The new Lindenwald power station of the Cincinnati Northern Traction Company, at Lindenwald, a suburb of Hamilton, Ohio, was partially destroyed on Sunday afternoon, April 7, by a terrific wind storm. The station was rapidly nearing completion and was designed for an ultimate capacity of five 1500-kw Westinghouse turbo-alternators and one 750-kw turbo-

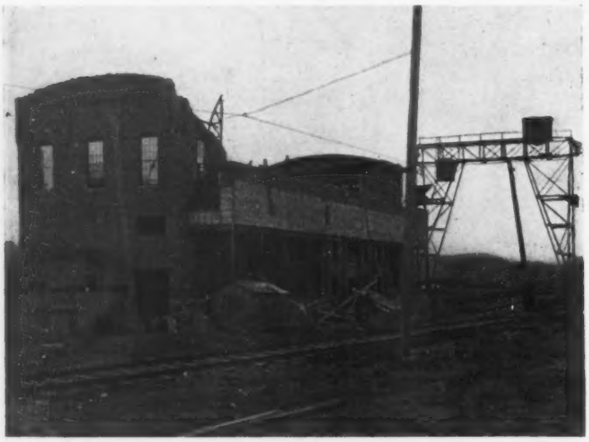


FIG. 1.—GENERAL VIEW OF THE WRECKED STATION.

alternator of the same make. These were placed on the second floor of the building, the first floor being occupied by the boilers.

The outer walls of the building are constructed of brick and the floor of the turbine room is of reinforced concrete, resting on 24-in. I-beams supported by iron columns. The concrete roof was in process of construction and a roof form of light pine was built over the entire station. A small portion of the roof at the north end had already been completed at the time of the accident, and, as will be noted in one of the engravings, withstood the storm. During the height of the storm, the wind lifted

FIG. 2.—VIEW OF GENERATOR ROOM, SHOWING WRECKAGE.

the entire roof form from the building and carried it across the coal storage bins, a distance of about 100 ft. to the east. With the roof form, went the roof trusses; and in dropping to the ground, the former was reduced to kindling wood and the latter were twisted out of shape. Simultaneously with the carrying away of the roof, the east and west walls of the building above the turbine floor, being left unbraced, fell; and the five turbines which were in process of erection as well as much of the smaller machinery were buried beneath a mass of brick.

Two of the turbines had their cases in place and were practically uninjured; but the other three, which were more or less exposed, were badly damaged, one being a complete wreck. The case of the latter was broken in two and the blades of the runner so bent and broken as to be of no use. The spindles of the other two turbines had much of the blading broken and bent, and many of the stationary vanes in the cases were destroyed. The Lafayette Engineering Company, of Lafayette, Ind., was the building contractor and with the Westinghouse Machine Company is a heavy loser. The loss to the building and machinery is estimated at $40,000, and is not covered by insurance. The general view of the station from the northwest shows the coal handling crane and the lifting crane, both of which were uninjured. It will also be noted that only the upper story suffered. A view of this floor is also given. The turbines that were left uninjured are shown and in the foreground may be seen the damaged rotor of one of the other turbines. The position of the twisted roof trusses is also shown. The station is very compact and in its arrangement is a departure from general practice.

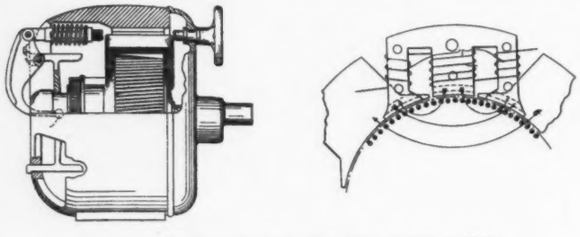
American Museum of Security.

A meeting of the Advisory Committee of the American Museum of Security was held on April 11, at which time, in addition to the routine business of the organization, several interesting announcements were made. A letter was read from Mr. Francis H. Richards offering a gold medal to be awarded at the next exhibition for the best invention shown relating to automobiles and motor-boats. It was announced that Dr. L. L. Seaman had offered an annual prize of $100 for the best essay on the subject of safeguarding life, the essay to be a study of existing conditions and methods for their improvements.

The organization of the Advisory Committee, consisting of numerous technical editors, was completed by the election of Mr. Charles Kirchhoff as chairman, and Mr. T. C. Martin as vice-chairman. It was decided that a committee of three be appointed to award the Richards gold medal; a committee of three experts be appointed to pass on the merits of devices to be displayed at the museum of safety, and that a third committee of three be appointed to award the Seaman essay prize. It was further decided that a committee of nine be appointed to award the gold medal, which was mentioned on page 622 of our issue for March 30.

Variable-Speed Shunt-Wound Motor.

A patent issued March 12, to Mr. J. C. Lincoln, describes means for controlling the magnetic field of a variable-speed shunt-wound direct-current motor so as to prevent sparking at high speeds. A screw mechanism is arranged for withdrawing



FIGS. 1 AND 2.—LINCOLN VARIABLE SPEED MOTOR.

the armature laterally from the field structure in order to decrease the value of the flux passing through the armature. Beyond the field structure and adjacent to the armature when moved to its high-speed position is an electromagnet whose coils are connected in series with the armature and afford a commutating field. As shown in Fig. 2 the auxiliary magnet is provided with three poles; the inner pole carries the main exciting coil, while two coils oppositely wound are mounted on the exterior poles so that their magnetomotive force may decrease the effective magnetism threading the armature and thereby prevent the usual drop in speed under heavy loads.

Report on Municipal Ownership in Nebraska.

A very interesting report has been made by Profs. C. R. Richards and G. H. Morse on Lincoln with its municipal lighting plant, as compared with Omaha under private supply conditions. Considered from all directions, and including all amounts which two trained disinterested statisticians say should be charged, Lincoln street lighting costs $98.84 per lamp.

In Omaha, where a private lighting company has the contract, a rate of $75 an arc light is made, and from this $75 rate there are certain reductions because of taxes and royalty which brings the cost of Omaha lights to only about half that of the Lincoln municipal lights.

Lincoln and Omaha are only 50 miles apart. They have practically the same freight rate on coal, wages are practically the same and other business conditions are so similar as to be practically the same. The issue raised, therefore, can be compared between Omaha and Lincoln probably better than between any other two cities in the country.

The report made by Profs. Richards and Morse says, in part:

"In order to obtain the annual cost to the city of owning and operating its own electric light plant, taking into account all financial features involved, the following estimate is made:

"Interest on bonds (4½ per cent on $65,000), $2.925; interest on cash cost of plant ($87,302.97), less $65,000 at 5 per cent, $1,115.15; depreciation and repairs at 10 per cent, $8,730; coal, $8,175.60; oil and waste, $275; packing, $78; miscellaneous, $50; carbons, $481.12; arc globes, $218.68; payroll, $7,511.46; taxes, at 7½ mills per $1, $654.77; fire insurance at 2 per cent on $32,000, $640; boiler insurance, $200; franchise tax, $100 per annum, plus 2 per cent on estimated gross income of a private plant, $700. Total, $32,519.08.

"The taxes which figure in the above are those which the city would receive from a private company doing the lighting, and which are, therefore, lost through the city's operation.

"The figures just found are for 329 arc lamps operating all night, every night, and also include the small quantity of incandescent lighting. The effect of the latter is negligible."

Electrical Measuring Instruments.

In a paper read before the New York Electrical Society, Mr. A. O. Benecke gave a description of the constructive details of permanent-magnet moving-coil measuring instruments. One of the most vital parts of such an instrument is the magnet, the construction of which involves the problem of obtaining a permanent and uniform magnetic field. By the use of curved pole pieces and a concentric core of soft iron the problem has been successfully solved. The second vital element is the moving coil which rotates within the annular space left between the pole pieces and the core. The convolutions of the coil are usually wound on a light metal frame which not only serves as a support for the wire but also renders the indications of the instrument dead beat.

The proper winding of the moving coil depends necessarily upon the controlling force which, in turn, depends upon the total weight and the momentum of the moving system; the best relation of the three factors can best be found by experiment. The best method of supporting the movable coil in the magnetic field consists in using cylindrical steel pivots journaled in regular watch jewels. A flat spiral spring is usually employed for supplying the controlling force of the moving coil. It seems to be desirable, at least for milli-voltmeters and ammeters, to separate the leading-in and leading-out conductors from the controlling spring. Such a construction allows the material for the springs to be selected with reference to its supporting power, quite independent of its ohmic resistance. The wonderful sensibility of electrical measuring instruments will be appreciated when it is learned that a force of .25 of a milligramme acting on a radius of 1 cm is noticeable on the instrument scale. This sensibility is at least equal to that of the most delicate chemical balance.

Meeting of the New York Section of the Illuminating Engineering Society.

The meeting of the New York Section of the Illuminating Engineering Society, held on April 12, was devoted to the discussion of numerous subjects relating to illumination, although no signed papers were read. A most instructive talk concerning the extent to which the distribution of light above the lamp can be modified by reflectors or globes was given by Mr. V. R. Lansingh. By means of lantern slides showing about 50 different photometric curves and giving photographs of the combination of lamps and shades to which the distribution of illumination was due, the ability of the different designs of glassware to place the light where desired was strikingly illustrated. One of the most valuable features of the demonstration related to the fact that the photometric curves from lamps and glasswares apparently similar in every respect differ enormously. It is evident, therefore, that in the selection of reflectors or globes for obtaining a desired distribution of illumination, reliance cannot be placed on the external appearance of the apparatus, but resort must be had to the photometric curves.

A written contribution to the discussion of the above subject was received from Major E. L. Zalinski, dealing specifically with the effect of diffusing reflecting coatings on glass prismatic reflectors. It was shown that although clear prism glass reflectors give the highest illumination at the vertical and adjacent angles, the diffusing or coated reflectors give the highest values at 45 degrees from the vertical.

Dr. Louis Bell gave an instructive discussion of reflection and diffusion as found in electric lighting. When light passing directly from the lamp strikes a surface, it may be totally reflected or partly diffused, or a portion of the light may pass completely through the reflector and be diffused from the opposite side. The portion of the light which is reflected depends largely upon the character of the surface upon which it falls and the angle at which it strikes the surface. For the purpose of obtaining concentrated illumination, it is desirable that the reflectors be made of substances which do not permit of diffusion. In practical illuminating installations the light is both diffused and reflected, the two effects being superposed.

Mr. J. E. Woodwell called attention to the work which is now being done at the United States Bureau of Standards with reference to the selection of primary and secondary standards of illumination. The standards in use both in this country and abroad are being carefully studied and checked and it is hoped that excellent results will be obtained in this work. A report of this work will be published later in the *Bulletin* of the Bureau.

Mr. Preston S. Millar showed by means of photometric curves and Rosseau diagrams that considerable confusion exists concerning the proper ratings of inverted and upright gas lamps. Thus the photometric curve from an inverted gas lamp may show a very large area, and the area of the photometric curve from an upright gas lamp may be very much less, yet the latter may give off a larger spherical candle power. The reason for this condition is found in the fact that the light from the upright lamp passes out over a considerable area, while that from the inverted lamp is considerably concentrated. This fact was strikingly shown on the Rosseau diagrams, but could be only indirectly inverted from the ordinary photometric curves. Mr. Millar showed by means of photometric curves that the apparent illumination from a certain lamp and reflector is very different according to whether the measurements are made with the photometer close to the lamp or more distant from it. The disagreements in the results are to be attributed to the lack of application of the law of inverse squares to the photometry of lamps equipped with reflectors.

Mr. E. Y. Porter spoke of the numerous methods now in use for expressing the amount of illumination in any certain building. Thus the terms "watts per square foot," "candle power per square foot," etc., are in common use. He expressed the opinion that a more logical method of rating the illumination would be

represented by the mean foot candles multiplied by the area lighted and divided by the watts consumed.

Mr. E. L. Elliott stated that the makers of lamps seem to have invented the numerous methods of rating more for the purpose of rendering the expressions unintelligible to the layman than of using such ratings as would allow different illuminants to be directly compared. The proper and logical method of rating the illumination should be based on the mean spherical candle power.

Mr. C. A. Barton said that, quite independent of the fact that the illumination from an inverted gas lamp may be less than that from an upright lamp, the effect of the former is very much more pleasing than that of the latter. In determining the relative merits of the two types of lamp it is necessary to take these conditions into account.

Rowland Telegraphic System.

A special meeting of the American Institute of Electrical Engineers was held on April 15. Independent of the fact that the paper presented furnishes a valuable addition to the Transactions of the Institute, the meeting was rendered especially interesting on account of the presence of one of the Institute's two honorary members, Sir William Henry Preece, K.C.B., past-president of the Institution of Electrical Engineers of Great Britain, who presided. The paper of the evening, by Dr. Louis M. Potts, described the Rowland telegraphic system and its apparatus. This system, which has been described in these columns, is one in which the two features of multiplexing and printing are combined. The multiplex feature is accomplished by the synchronous operation of the instruments at the terminal stations. The printing is accomplished by a perfectly direct method; that is, no punched or otherwise prepared tape is used at either the sending or receiving station, but the printing is controlled directly from a keyboard practically identical with that of a typewriter. At the receiving station all operations are controlled from the keyboard at the sending station. The messages received are automatically printed in page form on a long band about 8 inches wide. In comparing the Rowland and Morse systems, it was stated that in the former the human element is reduced to a minimum by keyboard transmission and automatic reception, while in the latter the presence of the human element in every operation necessarily introduces corresponding inaccuracies. The output of a Rowland operator is practically double that of a Morse operator. To transmit a Morse message two skilled operators are necessary, while to transmit a Rowland message one typist is required.

The discussion was opened by Mr. Ralph W. Pope, who stated that most excellent results are at present obtained with the Morse system, and that the difficulties in learning the code are almost negligible. For way-stations and places where the telegraphic business is not large the Morse system will doubtless hold its own, but for communication between large cities some machine method is desirable, and the Rowland system seems to be excellent. He had witnessed a most satisfactory test of this system recently when a message, sent from New York to Boston and returned during the ordinary course of business, entailed a total time of only five minutes. He called attention to the fact that electric lighting has a serious rival in gas lighting; electric transportation has a competitor in steam transportation, but the electric telegraph occupies a field of its own in which it is supreme.

Dr. A. E. Kennelly called attention to the fact that telegraphy has remained stationary for many years; in fact, it may even be said to have receded. Several years ago a few printing equipments were in use, but it seems as though even they have been abandoned. While all other systems, such as the telephone and the electric railway, have discarded the ground return, the telegraph system has remained on the ground. Probably the lack of progress along technical lines accounts for the fact that while on the average each person sends one-third of a telephone message per day, he sends not over one telegraph message per year.

Mr. William Maver, Jr., remarked that the printing telegraph system is not applicable in all cases. Some of its advantages are more apparent than real; thus it is not possible to eliminate all operators from the receiving end. Although in the printing system the message received is an exact duplicate of that transmitted, and hence certain elements of error are eliminated, it is not proper to ignore the fact that in the Morse system the receiving operator frequently calls the attention of the sending operator to errors which are corrected before the telegram is delivered.

Mr. H. G. Stott said that his attention had recently been directed to the fact that almost no papers on telegraphic subjects had been presented before the A. I. E. E. within the last ten years. He expressed the opinion that the seeming lack of progress along engineering lines by the telegraphic men might indicate the reason for the recent increase in telegraphic rates.

Dr. E. F. Northrup remarked that Dr. Potts' paper is one of the most important that has been presented before the Institute in many years. The dominating feature of the Rowland system is that electricity is sent continuously along the line and the signals are made by reversal of certain impulses. Thus it is essentially different from those systems in which no electricity passes along the circuit except at the instant when the message is to be transmitted.

Mr. Gano S. Dunn remarked that the Morse system is particularly advantageous on account of its extreme simplicity. The Rowland system, however, is very complicated and its use will probably be limited to congested districts.

The discussion was closed by Sir William Henry Preece, who said that he had been interested in telegraphy since the year 1852. He stated that the principal reason why machine telegraph systems have not been more generally adopted resides in the fact that there is no direct demand for telegraphic speed of 600 words per minute. In many cases the Morse system is sufficiently rapid. In England excellent results have been obtained from the Wheatstone system, which is abundantly able to take care of enormous peak loads. In America the peaks do not occur simultaneously over the whole country on account of the differences in time. Thus the peak at San Francisco would not interfere with the peak at New York, and the Morse system is much better able to handle the telegraphic communication in this country than would be the case in England.

Electric Road from Milan to Genoa.

U. S. Consul J. E. Dunning reports that an electric railroad 85 miles in length and to cost $47,000,000 is to be built between Genoa and Milan, the following being the particulars. The electrical power will be generated by water power by three engines of 24,000 horse-power. To complete the line 19 tunnels will have to be built, the most important being 12 miles long, which will require six years in its construction. The cost of the road will be about $500,000 per mile. The line will have a double track, the trains being hauled by electric locomotives. The latter will be combined with baggage cars, with two sets of trucks, having four motor axles, each axle of 300 hp. and will weigh 45 tons. With this they will be able to operate at the speed of about 54 miles an hour over the parts having a grade of 8 ft. per thousand and at the speed of 80 miles an hour on the level. The trains will be run in three cars, each car carrying 50 persons—the whole train weighing 150 tons. These figures are for the express and local trains. The plan is to have them running from 4 o'clock in the morning till midnight. The express trains will run every two hours. The locals will run much oftener, and will collect passengers from the smaller towns and take them to the express station further along the line, where passengers can transfer. All locals will, after leaving Milan, take all passengers collected from the smaller stations to the station of Tortona—the only express station—as well as those locals starting from Genoa. The express trains will take passengers from Milan to Genoa, or vice versa, in one and one-half hours, while the locals will require two and one-

half hours. In this way there will be 20 trains per day, carrying an average of 6,000 persons.

The 70 to 100 freight trains to run each 24 hours will have combination locomotive and baggage cars of the same size and power as those of the passenger trains, and will pull 30 freight cars, each car weighing 22 tons, which includes 12 tons of goods on each car, so that the train will pull in all 700 tons. These trains will run at the speed of 20 miles an hour on the inclines, and about 35 miles an hour on the level.

To prevent accidents, there will be no grade crossings along the line, and 372 bridges must be built. The principal tunnel will be perforated from both ends at once, and at the same time in eight places along the lines, boring holes from above. In all, this tunnel will be constructed from ten borings at the same time. By the time this tunnel is ready the whole line will be finished.

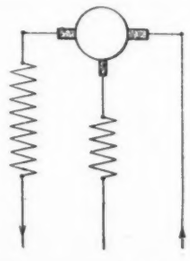
Independent Telephony in Indiana.

The first regular quarterly meeting of the Seventh District Branch of the Indiana Independent Telephone Association was held in Indianapolis, April 10. Delegates were elected to the International Convention in Chicago on June 4, and to the Annual State Convention to be held in Indianapolis, May 15-16. In addition to the large amount of improvements already made this year the representatives named many others contemplated which will call for a large expenditure for new material and equipment during the year.

Following the reports and the discussions the question of the advisability of accepting the proposition of the Central Union Telephone Company to close its local exchanges in many towns and cities in consideration of securing the toll-line business of the independent companies was very warmly discussed. A diversity of opinion developed at once and the discussion was closed by the adoption of a resolution declaring it to be the sense of the Seventh District members that no such deal should be entered into unless made to include the entire state, and further, that it was a matter for the State Association to dispose of and not one for district or individual action. The vote for officers resulted in the election of W. W. Mendenhall, of Westfield, president, and A. J. Newsom, West Newton, secretary-treasurer.

Three-Wire Generator.

An objection which has been urged against the usual three-wire generator relates to the fact that, since the series field winding is arranged in two parts, it is necessary to duplicate the equalizer conductors when several compound-wound machines are to be connected in parallel. In a patent issued April 2, Emanuel Rosenberg proposes to connect the main series winding in only one of the outside leads and to provide a supplementary winding in series with the neutral conductor of the system as indicated herewith. The supplementary winding is provided with half the number of turns of the main winding and is electrically so connected in circuit that its magnetism adds to that of the main winding when the two are traversed by currents flowing in the same direction. It is evident that when the two sides of the three-wire system are equally loaded there will be no current flowing in the supplementary winding, while when a difference of load occurs this winding will be traversed by a current equal in value to the difference between the currents in the two outside mains. In other words, the supplementary winding is traversed by current which is the algebraic sum of the currents in the outside mains.

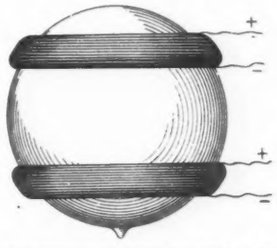


ROSENBERG THREE-WIRE DYNAMO.

Mercury-Vapor Apparatus.

Two patents issued February 15 to Mr. Peter Cooper Hewitt relate to methods and means for dispensing with leading-in wires for mercury-vapor lamps. The mercury-vapor path is employed as a single-turn secondary circuit of a transformer with a multiple-turn primary, as shown in the illustration. The primary turns are arranged for producing from three to fifty volts per inch in the vapor secondary in a lamp having a diameter of, say, three inches. It is preferable to operate the lamps with high-frequency current, such as that obtained from condenser discharges.

On February 26, two patents were issued to Mr. Percy H. Thomas on means for producing vacuum in mercury-vapor apparatus. According to one patent, aluminum in the solid state is inclosed within the container of a mercury-vapor lamp. When the lamp is tilted so as to bring the mercury into contact with the aluminum for producing an amalgam which possesses the capacity for reacting upon such injurious gases as may be present, the exhaustion of the apparatus is greatly improved. The second patent relates more to the use of the vacuum obtained by means of mercury than to the employment of mercury in a vacuum. The mercury is placed in a receptacle distinct from the vessel which is to be exhausted of air, the receptacle being connected to the vessel by a glass neck which can be sealed off when the operation is complete. Both the mercury and the vessel to be exhausted are first heated so that the mercury vapor completely drives out all air, and the exit tube is sealed off. The vessels are then subjected to the influence of cooling mediums, so that the mercury vapor is condensed and returns to the receptacle. The interconnecting neck is then sealed off, and the operation is complete.



INDUCTION MERCURY-VAPOR LAMP.

Pensions to Professors.

Dr. H. S. Prichett, president of the Carnegie Foundation for the Advancement of Teaching, in an official paper, gives reasons why in his opinion the pensions for professors, provided by the Foundation, should not be made available for the faculties of State-supported universities. He admits that their work is of the same order and of the same devotion as that done in private universities, but he points out that the State institution has a mission apart from its mere teaching function. It stands for the vital connection between education and practical democratic government. Dr. Prichett thought that if pensions were offered to the professors employed in State universities the sense of responsibility for education would be materially weakened among the Legislatures. Finally, he stated that if the State universities were admitted to the benefits of the foundation at once they would immediately absorb all the available funds, and the foundation would no longer be able to exercise a healthful influence upon the development of education in America.

CURRENT NEWS AND NOTES.

UNION TELEGRAPHERS—According to the president of the Commercial Telegraphers' Union, more than 700 operators of the Western Union Telegraph system have joined the union and it is expected that a large proportion of the remainder will join within a short time. The "remainder" is a good many thousand strong.

NATIONAL ELECTRIC LIGHT CONVENTION.—About two-thirds of the exhibition sections in the large ball room of the New Willard Hotel, Washington, have already been taken by the associate members. The committee is considering an unusually interesting display of electrical decorations which will greatly add to the attractiveness of the exhibition as a whole.

LIGHTING IN TURKEY.—According to the *Levant Herald*, the Turkish Ministry of Public Works has approved the plans for the establishment of an electric power station at Saloniki for electric lighting and traction in the town. The works will be carried out under the supervision of Hamdi Bey, inspector of telegraphs (Constantinople), and Menekche Effendi, municipal engineer (Saloniki, Turkey).

THREE-CENT FARES IN CLEVELAND.—According to a dispatch from Cleveland, the three-cent fare test in that city is a failure. In its report to the City Council the Cleveland Electric Railway Company says that the operation of cars at a three-cent fare, in accordance with the avowed policy of the city administration, is a losing venture. The report says that the cost of carrying passengers was in excess of three cents.

NEW INDIANA CORPORATIONS LAW.—Under the new law all foreign corporations wishing to conduct or operate light, heat, power, water or other public utility plants in Indiana, must file an application for admission to do business in the state, setting forth the character of the business proposed and where the plant or plants are to be located. Also, all foreign corporations heretofore or hereafter admitted to the state to conduct a public utility business must file an annual report of the condition of the plant and business, showing assets and liabilities; and notice of all increases in the capital stock.

NEW YORK & PANAMA CABLE.—The shareholders of the Central & South American Telegraph Company have unanimously approved the project of the directorate to lay a direct cable between New York and Panama. The cable is to have a length of 2200 miles, and there will be only one intermediate station, namely, at Baracoa, Cuba. The same company propose to introduce into the service a telegraph line along the routes of the railway companies of Oran, Argentina, and Buenos Aires, on the Pacific, and the establishment of a new land telegraph between Buenos Aires and Valparaiso. All these improvements are to be put in operation in 1907.

CHICAGO TROLLEY PLANS.—The formal acceptance by the Chicago City Railway directors of the street car ordinances approved by the voters at the recent city election which took place on April 12, marked the first step toward the rehabilitation of Chicago's traction systems at a stipulated cost of $40,000,000. It is the first fruits of victory by the new Republican administration in defeating plans for municipal ownership. Mr. Bion J. Arnold, Chairman of the Board of Supervising Engineers, stated that the first steps toward reconstruction would be retrackage. The action taken by the City Railway Company is expected to be followed by the Union Traction Company.

OWNERSHIP IN INDIANA.—Mr. M. J. Francisco has been in Indiana and has compiled a report upon the operation of municipal lighting plants in that State. According to his showing, municipal ownership has been such a general failure that many cities and towns have already abandoned and sold their municipal plants, and the indications are that several others will do likewise soon. He claims that poor service due to deterioration of municipal plants, high cost to taxpayers, and political mismanagement has naturally resulted to bring them into disfavor. He also states that the towns and cities which have given up their plants and now obtain private lighting service are highly gratified over the change, while other towns which still operate their own works find the tax rates steadily increasing, the discontent of the citizens growing. According to his compilation, Cherubusco spent $25,000 for a lighting plant, was unable to make the first payment on its bonds and sold the plant. Dunkirk, Madison, Malone, Michigan City, Martinsville, Mishawaka, Wabash, Montpelier and Linton have sold their plants after various periods of failure. He states that the Malone plant was sold at a loss of $7,000; the Michigan City plant brought only $2,800; the Wabash $18,000 investment was sold for junk, and the Montpelier outfit cost $38,000 in loss.

WESTERN SOCIETY OF ENGINEERS.—Mr. Thomas B. Lambert, of the Chicago Telephone Company, addressed the electrical section of the Western Society of Engineers of Chicago, April 12 on "Power Work as Related to Telephone Communication." He described particularly the power equipment employed by the Bell companies with special reference to Chicago, their standard practice being to use 24-volt, 11-cell storage battery for talking and lamp signal purposes with alternating and pulsating current motor-dynamos for ringing signals. In the main exchange of the Chicago Telephone Company at the peak load of the year, the day before Christmas, for about two hours the energy required from this 24-volt storage battery with its motor-dynamo-charging sets rose as high as 20 kw, indicating that an average of 5000 pairs of subscribers were talking at once. He dwelt at length on the precautions necessary to insure freedom from interruption, and paid a high compliment to the continuity of the central station service in Chicago from which the Chicago Telephone Company gets its supply of energy.

ANOTHER McGILL FIRE.—Last week we recorded the destruction by fire of the MacDonald Engineering Building at McGill University, Montreal. Early in the morning of Tuesday of this week another disastrous fire occurred at the university. This time the medical building, one of the oldest and most valuable of the group, was almost entirely destroyed. The damage is placed at $500,000. The magnificent medical library was saved, although in a damaged condition. The museum, which contained many valuable specimens, the collecting of which covered 70 years, was completely destroyed, the loss being irreparable. Dean Bovey, of the Faculty of Applied Sciences, McGill University, in a communication says with regard to the recent fire which destroyed the MacDonald Engineering Building: "We are, indeed, in very great straits at present and the disaster is one which we feel it difficult to realize. The whole of our Engineering Building with its equipment has been practically destroyed and the loss will amount to not less than three-quarters of a million dollars. In addition to this, some of our professors, including myself, have lost all our notes of experimental work, apparatus, etc., and books which we have been getting together for the last 10 to 20 years, and much of this work can now never be replaced. We are immediately proceeding with the reconstruction, and as we can cover in the whole of the ground floor and have the whole summer before us, we shall be able to utilize the whole of our laboratories in September, so that there will be no break in the continuity of the work and no diminution in the efficiency of the instruction. One of the losses which we feel most acutely is that of our technical library of 6000 volumes. Excepting a few volumes which happened to be out of the building at the time of the fire, the whole of these volumes have been utterly destroyed and nothing is left but charcoal." Dean Bovey is making an appeal to technical publishers and engineering institutions for help in forming a nucleus for a new library.

ITALO-SWISS TELEPHONY.—In accordance with the arrangement between the two Governments of Italy and Switzerland, night telephone rates between points in those countries have been established at three-fifths the regular tariff for three-minute service between the hours of 9 in the evening and 7 in the morning in summer and 8 in the morning in winter.

A CONFERENCE ON TRUSTS.—The Executive Council of the National Civic Federation has decided on Chicago as the place and May 28, 29, 30 and 31 as the time for holding the National Conference on Combinations and Trusts. Representative men throughout the country have signed the invitations already sent out, asking the appointment of delegates by governors and presidents of the important commercial, manufacturing, agricultural, labor, economic, financial and law associations. The purpose of the conference is to consider the trust problem, especially from the standpoint of State and Federal regulation.

HIGH RAILWAY SPEED.—In a discussion of "The Railway High-Speed Mania" in the May *Scribner,* Mr. B. B. Adams, of the *Railroad Gazette* editorial staff, says that the most difficult problem in safety is the personal equation—the securing of clear heads and efficiency in emergencies. Owing to the great growth of railroad traffic in the past few years good men are scarce, and no amount of automatic apparatus can entirely eliminate the inefficient engineer. Mr. Adams discusses many other phases of the question which has recently agitated the public press, and has been prominent in the public mind on account of the frequency of distressing accidents.

COST OF CITY GOVERNMENT.—In New York, the Bureau of City Betterment of the Citizens' Union has prepared a statement showing what the City Government costs and what each department and officer of the departments is doing. There is at present no means whereby officials or the public can learn in detail how the city is being administered. The bureau now proposes to collect, analyze and publish facts relating to the government of the city in the same way, as far as its funds will permit it to do so, as the Carnegie Institute is doing for science. Those in charge of the work will be Dr. William R. Patterson, ex-Register of the Tenement House Commission, and State Statistician for Iowa; George C. Sykes, ex-Secretary of the Committee on Local Transportation of the Chicago Council, and Henry Bruere, who has been in charge of the work from the beginning.

TROLLEYS IN INDIA.—U. S .Consul-General W. H. Michael reports as follows from Calcutta: "The progress of the mining industry of Mysore State is shown by the fact that the government has issued an order under the Mysore Tramways Regulation Act of 1906 authorizing the construction by the Mysore Manganese Company (Limited) of a tramway (electric line of railway) from the Shimoga railway station to the manganese mines near Kumsi in the Shimoga district. I do not know whether American engineers and American manufacturers of electrical materials for tramways have a hand in all the work going on in Mysore or not; but if they have not it is their own fault, for I have been assured by an American at the head of an important tramway that American engineers and American-made materials used in the construction of electric plants of this kind are popular and in demand."

NEXT TO CHRISTIANITY.—Only reverence appears to prevent Mr. H. H. Rogers from placing petroleum ahead of Christianity as a factor in civilization. In expressing the opinion that the country is and will continue prosperous, he points to all the evidences of material wealth and growth and says: "Take, for instance, the history of the petroleum development of the world. It is full of providential happenings. New fields have been discovered as fast as needed, and from 2000 barrels in 1859, the production has become so great I can't carry the figures in my head. Petroleum, providing illumination that now changes darkness to daylight in homes all over the world, has been the greatest civilizer outside of the Christian religion that humanity has known, and its discovery and development in Pennsylvania and West Virginia, in Texas, in California, in Russia, and everywhere it has been found, seem to have been made at just the time when needed and when the people were prepared for its use."

WIRELESS IN ENGLAND.—The Select Committee of the House of Commons appointed to consider the Radiotelegraphic Convention, signed at Berlin last year, met recently to take more evidence, Sir John Dickson-Poynter presiding. Colonel Daniell, Assistant Director of Naval Intelligence, gave evidence on behalf of the Admiralty, which, he said, had acquired the right to use the Marconi patents for eleven years from 1903, and the Marconi Company were bound under the agreement to communicate to the Admiralty immediately on their discovery any improvements in apparatus. The Admiralty paid the Marconi Company £20,000 down, and £1,600 royalty on each of 32 existing installations, and were to pay £5,000 annually during the continuation of the agreement. The Admiralty bound themselves not to interchange messages with other systems except in case of emergency. Before the delegates from Great Britain went to the Berlin conference many meetings were held. Subject to certain desiderata which were laid down the delegates had full liberty to come to an unbiased conclusion. The British delegates were always unanimous. The conference was practically unanimous in favor of the principle of the interchange of communication between different systems. Naval stations, however, were free from that except that they were bound to take signals of distress. The Government had unfettered discretion to make what arrangements it pleased in time of war. The Marconi system was not in general use in the Colonies, and it was clear that neither the Marconi system nor any other could be forced on the Colonies against their will.

SHORT FRANCHISES OBJECTIONABLE.—August Belmont, Controller Metz, ex-Lieut. Gov. Woodruff and several other men interested in traffic and the development of Long Island, delivered addresses last week at the first dinner of the Queens Borough Real Estate Exchange, when Controller Metz repeated his assertion that Mr. Belmont should have a monument built for him, and added: "The time is coming when we will cease to hound the corporations. Instead we are going to knock at their gates and beg them for God's sake to lay some tracks for us. While we are talking about how much the railroads are getting we are unable to get to our homes. While we are discussing the need of fresh air and parks for the masses we cannot get across the bridges to Brooklyn and the rest of Long Island." Mr. Metz said that Mr. Belmont deserved the monument "for taking a chance and building the Subway for us when no one else could see anything in the proposition." Mr. Belmont, in his speech, said in part: "Unfortunately there is a spirit of criticism against corporations prevalent. It would not be proper or becoming for me to criticize this spirit, but I know that this hostile spirit frightens the investor, and the moment hostility is started the corporations find it difficult to get capital with which to make improvements or additions. Conditions confronting us are not now what they used to be, and corporations find it difficult to get along in any community. They are threatened with regulation of all sorts. The regulation may be proper or it may be improper, but the threat militates against enterprise. If this condition prevailed when the Subway was first contemplated, I very much doubt if any corporation would have undertaken the great task of building it. I repeat that conditions are not attractive to capital. Short franchises are very well in theory, but when a man is going into business he wants something with safety or stability and definiteness. He does not want either to build up a business or buy it, if at the end of 25 years or less he finds that it has no value. I do not believe that the city is any better off for giving short-term franchises that it was when long-term franchises were given."

ELECTRICAL EXPORTS for the eight months including February and of electrical machinery alone, not including apparatus and scientific instruments, were $5,455,797 as compared with $5,031,898 in 1905-6 and $2,290,767 in 1904-5.

THE LINCOLN ELECTRICAL SHOW.—Mr. T. B. Mitchell, manager of the commerical department of the Lincoln Gas & Electric Light Company, who is at the head of the gas and electric exposition to be held at Lincoln, Neb., has been advertising it with a half-page space recently in the Lincoln daily papers. This is claimed to be the only combined gas and electric exposition ever attempted. It is to be held at the city auditorium, April 22 to 27.

ELECTRICAL SMELTING.—Advices from Montreal state that the Canadian Government has granted a bonus on all ore smelted by electricity. The decision is the outcome of what are said to have been successful experiments made at Sault Ste. Marie, Ont., under the supervision of Government experts. The bounties are as follows: On pig iron manufactured from Canadian ore by the process of electric smelting, during the calendar years: 1909, $2.10 per ton; 1910, $2.10 per ton; 1911, $1.70 per ton; 1912, 90 cents per ton. On steel ingots manufactured by electric process direct from Canadian ore and on steel ingots manufactured by electric process from pig iron smelted in Canada by electricity, from Canadian ore, during the calendar years: 1909, $1.65 per ton; 1910, $1.65 per ton; 1911, $1.05 per ton; 1912, 60 cents per ton.

AID AT SEA.—At a convention of men interested in coastwise shipping along the Atlantic seaboard, to be held under the auspices of the New York Board of Trade and Transportation in New York City on April 17, plans will be formulated calculated to prevent a repetition of such a disaster as befell the steamer Larchmont in Block Island Sound on the night of Feb. 11 The conference is the outcome of a recommendation of the executive committee of the board, which was adopted. The executive committee urged that small vessels equipped with wireless telegraph apparatus should supplement the life saving crews along the coast and that all the passenger vessels also be compelled to maintain wireless telegraph apparatus. The plan of the committee, as it is generally understood, is to ask the government to provide at certain points along the coast vessels of small size, yet large enough to put to sea in all kinds of weather, and equipped with the wireless telegraph, so that if any vessel is in distress in the vicinity at any time the life savers' vessel may start on her errand of succor and mercy at once.

IN THE CASCADES.—Officials of the Great Northern Railway have completed plans for the substitution of electricity for steam for the operation of trains through the Cascade tunnel, one of the longest railway tunnels in the country. It is proposed to do away entirely with the use of locomotives for hauling trains through the tunnel, thus adding not only to the efficiency and convenience but to the safety of the operation of this section of the Great Northern. The energy for the electric plant will be obtained about 35 miles from the tunnel, where large water power can be developed. By construction of about two and one-half miles of waterway it will be possible to obtain a head of 140 ft., which will supply all the power that can possibly be needed. Under the direction of President Hill the electric plant will be constructed in two sections, each one independent of the other, so that in case of a failure of a portion of the plant, the rest can be used. The Great Northern tunnel through the Cascade Mountains is built through solid granite. From portal to portal the tunnel is 14,400 ft. long, or between 2½ and 3 miles. The grade is about 1.7 per cent, one end being 240 ft. higher than the other. It is possible for trains running down grade through the tunnel to run through by gravity, without the use of steam. When electric service is installed locomotives will still run through it as now, but not under their own steam. The whole train, locomotive and all, will be pushed through the tunnel by large electric motors.

A LIGHTING COMPANY PROTECTED.—The Massachusetts Board of Gas and Electric Commissioners, at the appeal of the Haverhill Electric Company, from the action of the Haverhill Board of Aldermen, has refused to approve the locations granted to Charles H. Hayes, or to allow him to compete in furnishing electrical energy. The Board reviews the facts in the case and says: "If the existing company is not properly conserving the public interest and convenience, a condition arises which may not only justify but require the board to admit a competitor. In fact, the right of a gas or electric light company to continue to exist depends upon the performance of its public duties. The main object of the legislature in establishing such a corporation and granting to it the privilege of using the public streets in a peculiar manner is primarily the accommodation of the public and only incidentally the profit of the corporation itself. At the hearing little was said concerning the electric service furnished by the appellant. Some criticism was directed at its rates. No serious contention, however, was made that its service is inefficient or that it is unable or has refused or neglected to do its full duty of supplying the inhabitants of Haverhill with electricity at reasonable rates and without discrimination. Whatever the facts about its service may be, no complaint under the statute has ever been made to the board as to the quality or price of the electricity supplied, and in any event the appellant is conducting its business under the supervision of this board and the public can invoke the exercise of its powers as to quality and price. The burden rests upon any party seeking the right to exercise the privilege of selling electricity in a territory already served, to show that the interests of the public fairly require the board to exercise its discretion in favor of admitting him. In this case this burden has not been sustained."

CHICAGO TELEPHONES.—Prof. D. C. Jackson, W. H. Crumb and G. W. Wilder, the three telephone experts engaged by the city of Chicago to investigate the plans and proposed ordinance of the Manufacturers' Telephone Company have declared that "the project of the Manufacturers' Telephone Company is not feasible," and in a long report set forth their reasons for arriving at this conclusion and the other results of their work. One important conclusion which affects the telephone world was reached by the commission in regard to measured service. The members agree unanimously that measured service is the best service, as it makes each user pay in proportion to what he uses and keeps telephone lines free of frivolous messages. They also state that to require an operating company to make toll connections is not desirable for several reasons and that "telephone free trade" is not desired by the companies. Under the Manufacturers' project, the methods of charging and rates proposed were not adapted to enable the company to give first-class service throughout the city and pay ordinary interest on the investment after setting aside reserves for contingencies and depreciation. They reported that the company's operations if extended throughout the city would result in financial difficulties or an application to change their schedule of rates. The commission also said that a plant equal to that of the Chicago Telephone Company could not be constructed in less than double the time available and that the semi-automatic mode of operation proposed by the Manufacturers' company is untried as a commercial arrangement for use on a large scale and to introduce it might cause confusion. In regard to a flat rate they say, however, that a partial use of the flat rate may be applied in connection with residence and neighborhood exchange telephones. The commission recommended that if the franchise is given to the Chicago Telephone Company the company be required to start a separate set of records and books of account relating to its business within the city and that the city employ a consulting engineer to advise with the comptroller and the company on the best form of records to be kept in order that the costs of the different classes of service may be known.

Electric Arc Lighting Plant at Lynchburg, Va.

THE city of Lynchburg, Va., has recently had plans made and specifications drawn for an electric lighting plant which presents several unique and unusual features, among which are—it is one of the few plants designed within the past decade to supply arc lighting exclusively; it is a series alternating current plant but laid out to avoid the use of transformers between the generators and the series circuits; the generators may be driven by either steam or water power or both if desired, and when driven by steam power they run as direct connected units; the hydraulic turbines are doubled horizontal units despite the fact that the operating head is only 12 feet and usual hydraulic practice favors vertical wheels for such low heads.

The new gravity system of water supply for Lynchburg which will soon be put into commission, will leave the city in possession of a pumping station without any use therefor. This station is a fine brick building located on the bank of the James River, containing three pumps operated by vertical turbines. A dam twelve feet in height, about 1000 feet above the pumping station, provides for the water power used to drive the pumps. About a year ago the municipal authorities decided to consider the question of utilizing this building and the developed water power, after it ceased to operate as a pumping station. Accordingly Mr. Lamar Lyndon, of New York, was retained as consulting engineer to investigate the conditions with a view to determining the advisability of making use of the building as an electric power station. The preliminary report being favorable, Mr. Lyndon was engaged to prepare the plans and specifications, the designs here described being the result.

The flow of the James River is widely variable, and, during certain months in the year, is not sufficient to drive the full load on the generators. An auxiliary steam plant, therefore, must be installed to help carry the load at such times and also when floods are so great that the backing up of the tail water reduces the head to an inoperative value.

The floor of the old pumping station was too low and during unusual floods, the water would rise up above the floor level. Therefore it was necessary to elevate the floor about five feet above its former level.

The room taken as the generator room is approximately 50x60 feet. Near one side were the two wheel pits in which were placed the old horizontal turbines which served for driving the pumps.

The present plans provide for removal of the existing masonry between the two wheel pits and extending the single pit thus formed until a long open penstock 12 feet wide and 41 feet long is formed. Two horizontal turbines are to be put in place in this penstock, each carrying a 90-inch sheave wheel on the end of its shaft. A dry pit is formed for the sheaves and drive ropes by means of two steel-plate bulkheads. The turbine shafts pass through stuffing boxes riveted to the bulkheads. Owing to the comparative shortness of the wheel bays, every possible expedient for shortening the length of these units was resorted to. The flange connection between each turbine shaft and its sheave wheel extension shaft was made by forging the flanges on each shaft end instead of the usual cast-iron flange couplings which would require a foot or more of shaft length to accommodate the hubs of the couplings.

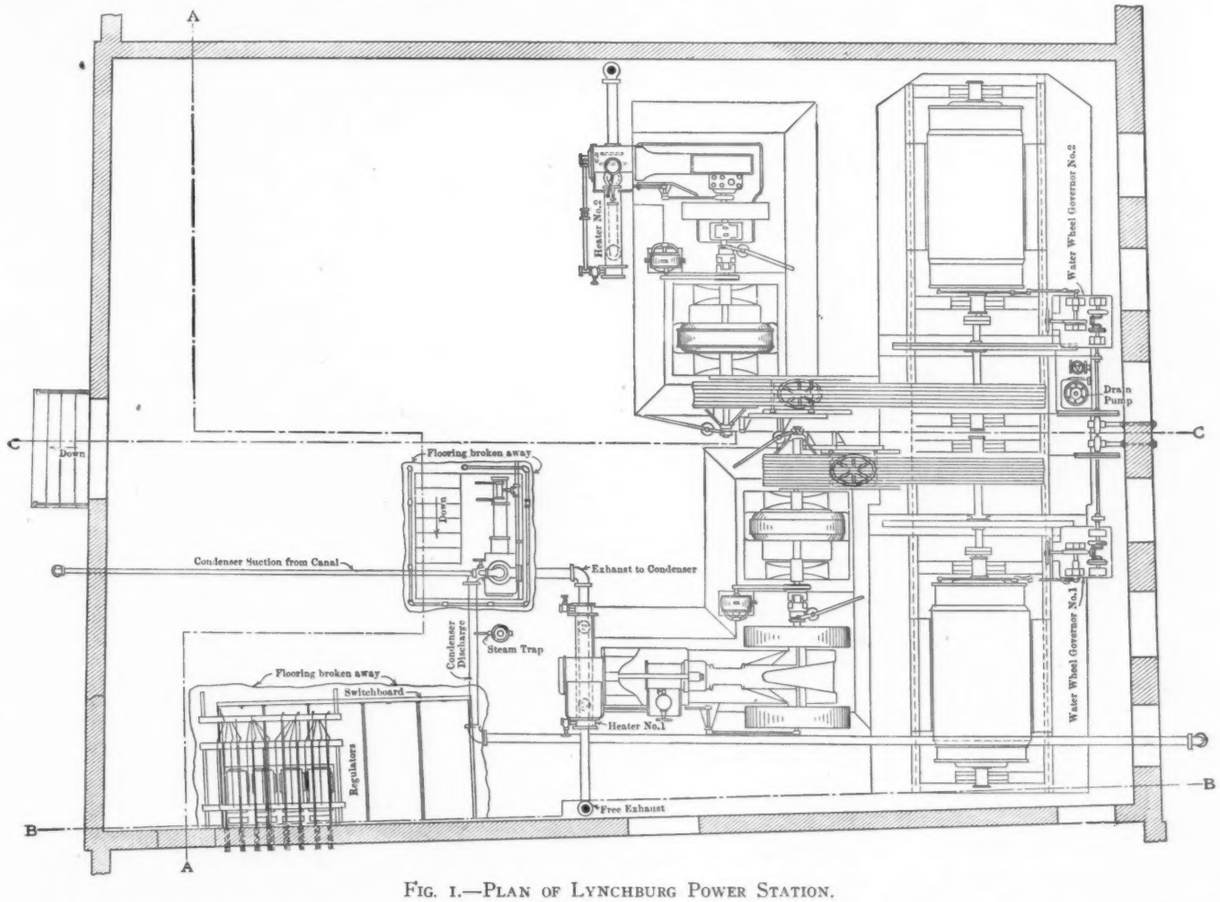


FIG. 1.—PLAN OF LYNCHBURG POWER STATION.

Another saving of some three feet in length was accomplished by using steel plate bulkheads instead of masonry or concrete partitions.

This whole arrangement is clearly shown in Fig. 1 which is a plan of the generator room.

Horizontal turbines were adopted in spite of the difficulties in placing them in the limited space and the very low head, in

order to avoid the continual troubles, expense and energy losses incident to the use of bevel gears to transform the vertical to a horizontal drive, and also to make use of double units which run at a higher speed than does a single wheel. Under such a low head the speed of a single wheel would be so low that the drive sheaves to give proper speed to a 120-kw standard alternating-current generator would fill nearly half the room.

The two units are to be 120 kw each, and no alternating-current dynamo of this capacity that is a commercial possibility can be obtained which will run at a sufficiently low speed to allow of direct connection with a turbine of any type working under a 12-foot head.

While it may appear curious to allow the low efficiency of the bevel gear drive to influence the design of the plant, it must be borne in mind that there are many days during the year when the water power available is just sufficient to carry the load, and if an excessive loss of energy takes place, the steam plant would have to be started. The cost of operation of the steam plant in cases like this depends more upon the frequency with which the fires are kindled and steam raised, than it does upon the actual load itself during the time of working under steam. Since the use of bevel gear drives would increase the number of days that the steam plant would have to operate, this factor was considered as important and another good reason for avoiding this character of drive.

Dynamos having a speed of 277 r. p. m. were selected and set in the position shown in the plan and sections (Figs. 1, 2 and 3). These have their shafts extended at either end. On one end is placed a 42-inch sheave wheel, which receives the drive ropes from the turbine sheave. The 42-inch sheave is connected to the dynamo shaft by means of a friction clutch. On the other end of the dynamo shaft is placed half of a jaw clutch coupling, which mates with a similar jaw coupling, the latter being fixed on the end of the engine shaft. The dynamo and engines are set with their shaft centers in exact coincidence. Obviously, when the friction clutch is set tight, the dynamo is driven by the rope drive from the turbine, and when the sheave is loosened, and the jaw clutches on the adjacent ends of the dynamo and engine shafts are thrown in mesh, the dynamos are driven by the engines, as direct connected units. With both clutches thrown in, the dynamo is driven by both the engine and turbine.

Owing to the possibility of the drive ropes getting wet and contracting, it was not possible to use a multiple drive. The continuous or "American" system was therefore adopted, with sliding tension carriages. The runways of the tension carriages are supported on special steel frames which lie below the floor level and between the two sides of the rope drive as indicated in Fig. 3. Each of the water wheel governors which are located near the rear wall of the room is driven by a single rope, which runs from an extra groove in the turbine sheave diagonally up to a 33-inch rope sheave on an extension of the governor drive shaft. The extension shafts allow the governors to be placed in the most advantageous position to control the turbine gates. In order to keep the exciters from being set too far out in the room, they are driven by silent chain drives which receive power from their respective dynamo shafts. To save longitudinal space on the shaft the chain drive gears are mounted on the hubs of the jaw clutches.

Fig. 4 is a detail showing the arrangement of jaw clutches and chain drive gear.

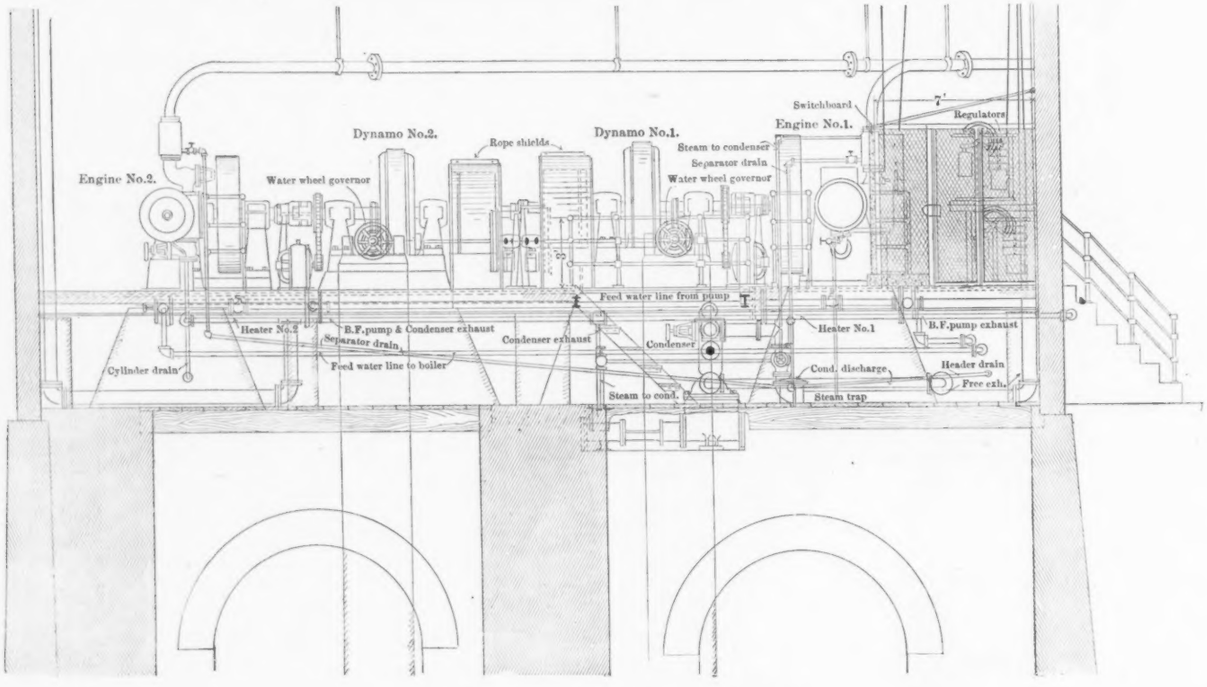


Fig. 2.—Transverse Section on A A of Fig. 1.

Steel shields cover the main drive ropes and the dynamo sheave wheels, extending from the floor up around ropes and sheaves. The whole of the rope drives—excepting the single governor ropes near the rear wall of the building—are thus protected and concealed.

The boiler room is adjacent to the dynamo room and separated therefrom by a fire wall. Two horizontal water tube boilers each having 1500 sq. ft. of heating surface are set in a single battery. A steel stack 54 inches in diameter by 100 feet high is to be installed. A single feed pump is provided for both boilers, and as a reserve in case of breakdown of the pump, ordinary injectors are used.

The steam piping is designed to be absolutely reliable and free from possibility of failure. The specifications are somewhat unusual in their requirements for this work. The flanges must mate truly, the corresponding holes reamed together so that they register exactly, and the connecting bolts are to be turned to fit in the reamed holes, with a light drive fit.

The floor beams in the generator room, carrying the reinforced concrete floor with their supporting piers are

shown in Figs. 2 and 3. The flooring over the turbine and sheave-wheel pits must be removable. Therefore this portion of the floor is made of rolled checkered steel plate, bolted to 8-inch I-beams which run longitudinally above the pits. These I-beams are in turn supported by four 15-inch I-beams which run transversely under the 8-inch top beams. The 15-inch I-beams rest on piers as shown. The 8-inch I-beams are bolted to the transverse 15-inch beams, and the checkered plate bolted to the 8-inch beams, so that the pits may be completely exposed by unbolting and removing the plates and the light longitudinal beams.

The dynamos are two phase and designed to supply 15 amperes per phase at 4200 volts. The lamps are to be supplied with 7½ amperes at 80 volts. This gives two circuits per phase with 50 lamps on each circuit or 200 lamps per generator. The generator voltage being adapted for the potential required by the lamp circuits, no transformers are needed or will be used. An inductive regulator is placed in each circuit which will, automatically, maintain a constant current of 7.5 amperes through the lamps.

The switchboard was specially designed to suit the requirements of this plant. It is quite simple, and comprises two exciter panels, 2 generator panels, 1 synchronizing panel, 4 plug switch feeder panels and 1 feeder instrument panel.

Since the generator voltage will start at a certain value and be gradually increased as lamps are added in the circuits the only suitable source of current for lighting the station buildings with incandescent lamps is from the exciters, and these machines are of sufficient size to carry this lighting load as well as to perform their required duty of supplying the generator magnetizing current.

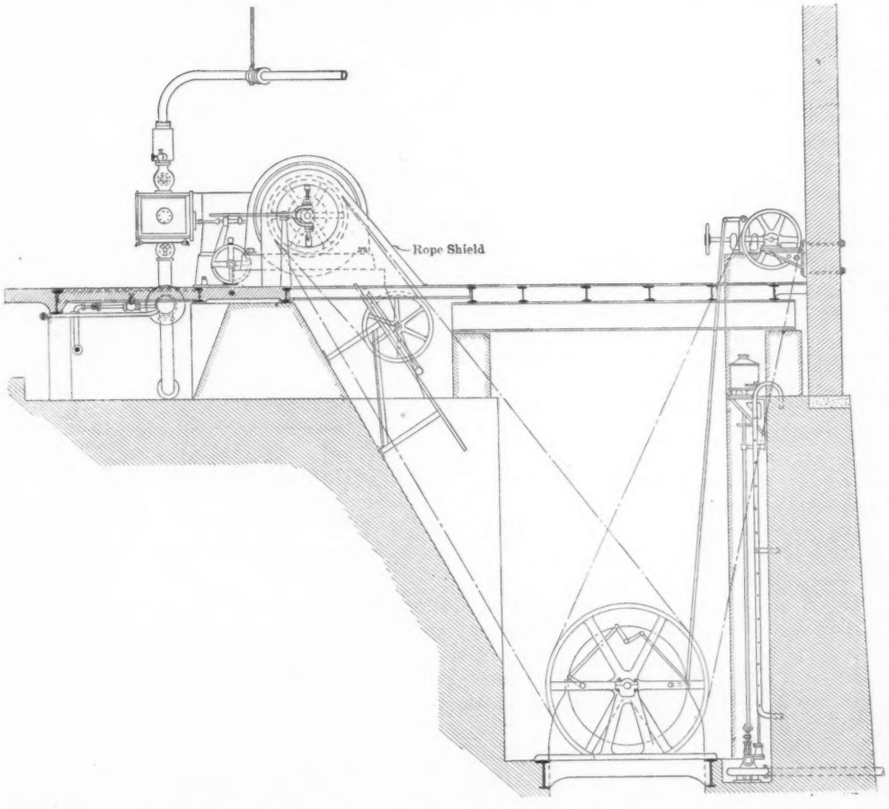


FIG. 3.—TRANSVERSE SECTION OF POWER STATION.

Each of the feeder panels has two sets of feeder connections thus supplying two circuits per panel or 8 circuits in all. Plug switches specially designed for this board are used, there being 7 plugs to each circuit. One pair of plugs connects the circuit to one phase of generator No. 1 while the pair of plugs, just above this first pair, will connect the circuit to the corresponding phase of generator No. 2. This gives a very flexible arrangement and in case of both sets of plugs being connected in at the same time through ignorance or carelessness, the only result would be the connecting of the two generators in parallel without damage.

Immediately above the second named pair of plug switches

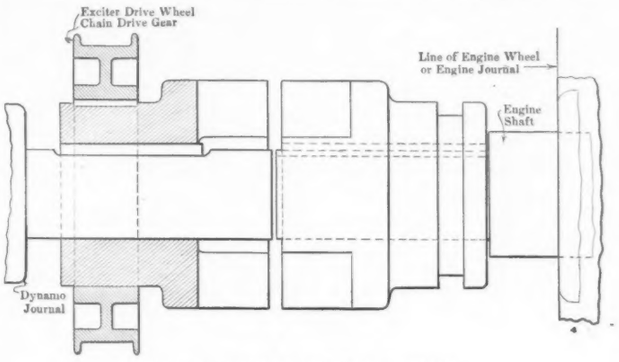


FIG. 4.—LINE OF ENGINE JOURNAL.

is a third pair of plugs, which connect with the feeder voltmeter and the ground detector. If one of these switches be closed, the ground detector will reveal a ground on the circuit. If both be closed the voltmeter will show the potential of the circuit after passing through the regulator.

The seventh plug switch is to short circuit the line in order to cut it out of service, the main plug switches being afterwards opened.

Above the two voltmeter plugs are two ammeter jacks, into which a special ammeter plug may be inserted. This plug is attached to one end of a flexible cable, the other end being connected with the feeder ammeter. By plugging into any of the jacks, the current in both the outgoing and incoming sides of any feeder may be observed. These two readings for the same feeder will differ if there is a double ground on the line, and the difference will indicate the magnitude of the ground.

The regulators, eight in number, are set in two tiers behind the switchboard, and they, and the rear of the board, are protected by grill work placed at either end, making with the board and the rear wall a complete enclosure.

The generator and exciter wiring to the switchboard is rubber covered and lead sheathed. This is carried below the floor. The feeders rise upwards from the rear of the board to insulators on a suspended framework near the ceiling and thus pass out through the wall, sloping downwards 20 degrees. Each wire passes through a 3-in. terra-cotta pipe sealed in the wall.

Mr. H. L. Shaner is city engineer of the city of Lynchburg, and the idea of utilizing an existing and otherwise valueless property is due to him. His efforts to have the matter brought to a satisfactory conclusion were greatly assisted by the Committee on Electricity, of which Mr. Leon Goodman is chairman.

Eddy Current Losses in Armature Teeth.

By F. E. Meurer.

ONE of the most uncertain quantities in electrical machine design is the eddy current loss in the armature teeth. The "orthodox" formula for determining eddy current losses:

$$W = \frac{\pi^2}{60}\left[\triangle \frac{f}{100}\,\frac{B_m}{1000}\right]^2 \qquad (1)$$

where

$\triangle$ = thickness of laminations in cm.
f = frequency
B_m = maximum value of magnetic density in c. g. s.
and W = watts per cubic cm;

is based upon the assumption of a sinusoidal time variation of the flux linking with the eddy current paths and a specific resistance of the iron of 10^{-5} ohms per cubic cm. If the time variation of the flux follows a different periodical function, the formula presents itself as follows:

$$W = \frac{4}{30}\left[\triangle \frac{f}{100}\,\frac{B_m f_e}{1000}\right]^2 \qquad (2)$$

where f_e is the "form factor" of the flux variation curve. Each formula disregards the self-inductance of the eddy current circuits, with its reducing effect upon the value of the eddy currents and consequently upon the losses, and the counter-magnetizing effect of the magnetomotive force of the eddy currents upon the main field, resulting in unequal distribution of the magnetic density and in consequence of that in an increase of the effective resistance of the eddy current path and therefore decrease of the loss. The conditions of practice, however, introduce phenomena, in themselves of secondary nature and not easily accessible to mathematical analysis, though producing effects, which affect the results very materially. For instance, applying formula (2) for the predetermination of these losses in the iron of transformers and checking the result by experimental data, it will be found that the actual loss is from 50 to 100 per cent higher according to Parshall and Hobart, or from 20 to 50 per cent higher according to Prof. Arnold, the actual value varying with the size and construction.

In the case of armature teeth, even greater discrepancies between the calculated and experimentally determined eddy current losses are encountered. Obviously the conditions are here much more complicated than with transformers, and the chances are much greater that stray lines induce eddy currents in such directions as to be imperfectly checked by the laminations, while the process of assembling and finishing the armature partly destroys the effect of the laminations at the surface of the teeth, giving rise to surface currents and additional losses. A beautiful experimental illustration of these conditions is given in Parshall and Hobart's "Electric Generators," where it is shown that the total core loss of a railway motor armature increased approximately 30 per cent by straightening the slots and by slight filing, and reference is made to a case where the milling of the slots increased the core loss three-fold. Considering the fact that the eddy current loss is only a part of the core loss, and that the loss in the teeth is only a part of the total eddy-current loss, it is obvious that the finishing process may easily double the proper eddy current losses in the teeth, even if the work is carefully performed.

There is another factor which must be considered, namely, the eddy current loss in the pole-faces. Since they cannot be separated experimentally from the core losses proper, they are ordinarily included in the latter. This procedure makes the value a "pessimistic" one. For solid poles and coarse tooth pitches the pole-face losses are quite considerable.

There are two distinct methods for dealing with those losses for the purpose of design, namely, to dispense altogether with the introduction of formulas for estimating the components of the total core loss and to base the whole problem entirely upon an experimental foundation, a method emphasized by Messrs. Parshall and Hobart; and the other method is to attach a correction factor to the orthodox formula for the component losses, the correction factor embodying the result of numerous tests and being properly estimated to suit different conditions, a way preferred by Prof. Arnold and others. According to Prof. Arnold, the eddy current loss in the armature teeth of large machines carefully constructed is from 2.4 to 3.0 times the orthodox value; for average sizes and conditions from 6 to 9 times, and for small machines and poor conditions from 12 to 18 times. It is hard to believe that such enormous differences can be accounted for solely by the presence of the additional losses mentioned above, and in the following the writer has made an attempt towards establishing a better agreement by adapting the orthodox formula to the special conditions in the armature teeth, without impairing its convenience for practical use.

Several simplifying assumptions have been made so as to avoid unnecessary complications. It is assumed that the flux through each tooth cross-section is the same as that through the other cross-sections, that, therefore, no stray lines enter into or issue from the sides of the teeth. Although this assumption is not correct, it is obvious that no serious errors can enter the calculation therefrom. The other assumption is that the variations of magnetic density along the pole-arc in the air-gap produce corresponding variations along the peripheral sections of the teeth, as shown in Fig. 1, a condition expressed by the relations

$$\frac{B_{a1}}{B_{a2}} = \frac{B_{t1}}{B_{t2}}; \quad \frac{B_{a1}}{B_{t1}} = \frac{B_{a2}}{B_{t2}} = \frac{\tau}{a} \qquad (3)$$

The variation of the magnetic density in the air-gap and the teeth follows approximately the law of the straight line, as indicated by the broken lines in Fig. 1. In Fig. 2 a cross-section of

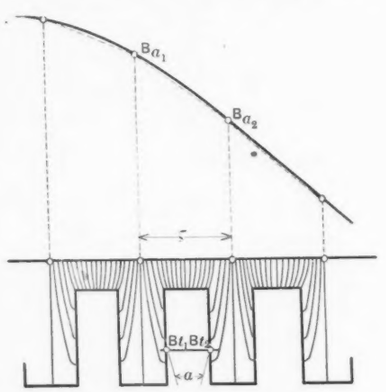


FIG. 1.—SPACE DISTRIBUTION OF FLUX.

one tooth lamination is shown. The movement of this cross-section through the magnetic field takes place perpendicular to the lines of flux and in the direction of the axis $O_1 O_2$. The elementary eddy currents flow approximately along rectangular paths as shown in Fig. 2. Since $\triangle$ is always small in compari-

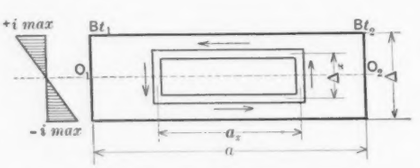


FIG. 2.—PATHS OF THE EDDY CURRENTS.

son with a, the ohmic resistance of the inducing sides $\triangle_x$ of the elementary path can be neglected in comparison with that of the long sides a_x. When such an elementary path with the inducing sides $\triangle_x$ moves through a magnetic field, the density of which increases or decreases evenly in the direction of the

movement, as shown in Fig. 1, the inducing sides become the seats of electromotive forces. The algebraic sum of these electromotive forces, which drives the eddy current through its elementary path, obviously increases proportional to the displacement a_x of the inducing sides $\triangle x$ in the magnetic field, but the ohmic resistance of the path increases also proportional to a_x. The intensity of the elementary eddy currents is therefore independent of a_x and is proportional to $\triangle x$; that is to say, they flow in lines parallel to the axis $O_1 O_2$, increasing in intensity proportional to their distance from the center line $O_1 O_2$, but having the same intensity along their paths parallel to it. The conditions, although actually much more complex, can therefore be expressed with a fair degree of accuracy by assuming that the eddy current paths in the cross-section under discussion are all of rectangular shape, one side being a and the other varying from O to $\triangle$. Any curve showing the distribution of the magnetic density along the air-gap is a periodical function and therefore can be resolved into harmonics according to Fourier's theorem. For obvious reasons all even harmonics disappear. The eddy current losses produced by the action of the individual field harmonics are determined separately below, and are summed up to give the total loss.

Assume that a winding of one turn and having 1 cm of inducing length and a span of τ (Fig. 3) moves through a sinusoi-

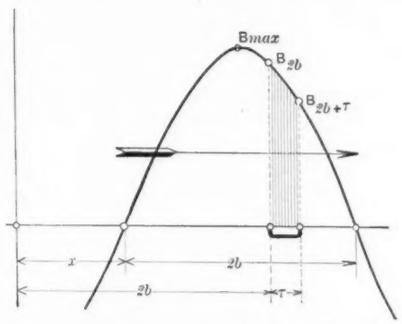


FIG. 3.—GENERATION OF ELECTROMOTIVE FORCE.

dal field of the maximum density of B_m and the pole-arc $2b$. The speed being v, measured in cm per sec, the frequency is: $f = \frac{v}{4b}$. The momentary induced e. m. f. e, in volts, equals $4\,b\,f\,(B_{2b} + B_{2b+\tau})\ 10^{-8}$. After some transformation there is obtained

$$e = \frac{8}{10^8} B_m\, b\, f \left(\sin \frac{2\pi\tau}{8b} \cos 2\pi \frac{2(2b-x)+\tau}{8b} \right) \quad (4)$$

From this expression the effective value has been found to be:

$$E = \frac{4\sqrt{2}}{10^8} b\, f\, B_m \sin\left(\frac{\pi\tau}{4b}\right) \quad (5)$$

or, introducing for the total flux the relation:

$$\phi = \frac{4}{\pi} b\, B_m \quad (6)$$

the effective value of the e. m. f. becomes

$$E = \frac{2\pi}{\sqrt{2}\ 10^8} \phi\, f \sin\left(\frac{\pi\tau}{4b}\right) \quad (7)$$

Applying this result to the problem under discussion, consider one elementary eddy current path with the sides a and $\triangle x$, $\triangle x$ being the length of the inducing sides. The width of the path equals $\frac{d\triangle x}{2}$ and the radial depth equals 1. Neglecting the resistance of the short sides $\triangle x$ and introducing the specific resistance of the sheet iron, as 10^{-8} ohms per cubic cm, the resistance of this path may be expressed in ohms by $\frac{4a}{10^8\, d\triangle x}$.

Although the span of the elementary turn equals a and not τ, the electrical displacement between the inducing sides of the winding remains nevertheless $\frac{2\pi\tau}{4b}$ in degrees, and the induced effective e. m. f. in volts may be written

$$E = \frac{4\sqrt{2}}{10^8} b\, f\, B_{tm} \triangle x \sin\left(\frac{\pi\tau}{4b}\right) \quad (8)$$

The loss, in this elementary winding in watts, is

$$dW = \frac{32}{10^{11}} (b\, f\, B_{tm} \triangle x)^2 \sin^2\left(\frac{\pi\tau}{4b}\right) \frac{d\triangle x}{4a} \quad (9)$$

and for the whole cross-section $\triangle a$ and the radial depth of 1 cm.

$$W = \frac{8}{3.10^{11}} (b\, f\, B_{tm})^2 \sin^2\left(\frac{\pi\tau}{4b}\right) \frac{\triangle^2}{a} \quad (10)$$

therefore for 1 cu. cm of laminations:

$$W_1 = \frac{8}{30}\left(\frac{b}{a}\right)^2 \left[\frac{f}{100} \frac{Bt_1 m}{1000} \triangle\right]^2 \sin^2\left(\frac{\pi\tau}{4b}\right) \quad (11)$$

The eddy current losses produced by the higher harmonic fields are determined in exactly the same way. The n^{th} harmonic field has a pole pitch of $2b_n = \frac{2b}{n}$, and, therefore, induces an e. m. f. of the frequency $f_m = fn$. Introducing these values into the formula for the n^{th} harmonic effective e. m. f. there is obtained

$$E_n = \frac{4\sqrt{2}}{10^8} b\, f\, B_{nm} \sin\left(\frac{\tau n \pi}{4b}\right) \quad (12)$$

and finally for the watt loss produced per cubic cm by the n^{th} harmonic field:

$$Wn = \frac{8}{30}\left(\frac{b}{a}\right)^2 \left[\frac{f}{100} \frac{Btnm}{1000} \triangle\right]^2 \sin^2\left(\frac{\pi n \tau}{4b}\right) \quad (13)$$

The total eddy current loss can now be expressed as

$$Wo = \frac{8}{30}\left(\frac{b}{a}\right)^2 \left[\frac{f}{100} \frac{Btm}{1000} \triangle\right]^2 \left(\frac{Bt_1 m}{Btm} \sin \frac{\pi\tau}{4b}\right)^2 + \left(\frac{Bt_3 m}{Btm} \sin \frac{\pi 3\tau}{4b}\right)^2 + \ldots \quad (14)$$

As seen in the table below, the sines can in most cases be replaced by the corresponding arcs and the formula can be written

$$Wo = \frac{\pi^2}{60}\left(\frac{\tau}{a}\right)^2 \left[\frac{f}{100} \frac{Btm}{1000} \triangle\right]^2 K \quad (15)$$

Where $K = \left(\frac{Bt_1 m}{Btm}\right)^2 + 9\left(\frac{Bt_3 m}{Btm}\right)^2 + 25\left(\frac{Bt_5 m}{Btm}\right)^2 + \ldots$

This formula is identical with the orthodox formula, but two new factors appear in it, one introducing the slot and tooth dimensions and the other one the shape of the magnetic field.

It is a well known fact that the eddy current loss is affected by the shape of the field, especially in the interpolar space, and that rounded pole corners and slanted pole tips reduce this loss. The value $\left(\frac{\tau}{a}\right)$ varies for large direct current armatures from approximately 2.0 to 1.4 and remains substantially constant for all tooth cross-sections; for small armatures, at the top of the teeth this ratio is from 2.5 to 2.0, increasing at the bottom of the slots to from 3.3 to 2.5; $\left(\frac{\tau}{a}\right)^2$ therefore varies from 1.9 to 4.0 for large machines and from 5.2 to 8.7 for small ones. In order to get data concerning the factor K, a number of field curves, published elsewhere, have been resolved into their har-

monics and the results are given in Table II. There are mainly two factors which determine the shape of the field curve, the ratios $\frac{\text{pole arc}}{\text{pole pitch}}$ and $\frac{\text{pole arc}}{\text{air-gap}}$; besides those the shape of the pole tips and the saturation of the teeth and pole tips are of more or less importance.

TABLE I

$\frac{\tau}{\sigma}$	$\frac{\pi}{4}\times\frac{\tau}{b}$		$\frac{\pi}{4}\times 3\times\frac{\tau}{b}$		$\frac{\pi}{4}\times 5\times\frac{\tau}{b}$		$\frac{\pi}{4}\times 7\times\frac{\tau}{b}$	
	Arc²	Sin²	Arc²	Sin²	Arc²	Sin²	Arc²	Sin²
$\frac{1}{4}$	.038	.038	.345	.308	.960	.694	1.880	.960
$\frac{1}{8}$	.025	.025	.222	.206	.616	.498	1.210	.792
$\frac{1}{12}$	.013	.013	.113	.107	.313	.281	.614	.497
$\frac{1}{10}$	.006	.006	.056	.054	.156	.147	.306	.274
$\frac{1}{16}$	.003	.003	.025	.025	.068	.067	.133	.128

TABLE II

Field Curves at no load.

Polearc / Polepitch	Polearc / Airgap	Per cent. of B max: B_1 max	B_3 max	B_5 max	B_7 max	REMARKS	K
.60	16	107.1	11.0	12.7	10.3	Sharp polecorners.	1.25
.60	16	102.1	8.8	12.7	1.9	Corners rounded off, radius=air gap.	1.12
.60	16	102.0	9.4	14.8	.3	Poletips slanted; length of slant=½ polearc.	1.12
.70	25	113.0	8.8	10.6	10.2	Corners rounded off, radius=air gap.	1.35
.77	16	111.2	7.1	16.5	8.7	Poletips slanted, length of slant=½ polearc.	1.28
.66	40	96.4	9.2	10.2	1.1	Excentrical air gap, corners rounded off.	1.02
1.0	—	128.0	42.5	25.5	13.2	Theoretical case of rectangular field-curve, extending over the whole polearc.	3.28

In estimating the coefficient K only the first and third harmonic fields have been used. The fundamental formula for the eddy current loss disregards the existence of reactance in the circuits of the edddy currents and the increase of the effective resistance due to screening action. It is obvious, therefore, that the actual losses will be smaller than indicated by the formula, and to take this fact in consideration, only the first and third harmonics have been assumed to produce losses. Table II shows that K varies from approximately 1.0 to 1.4, with 1.25 as an average value for direct-current machines of ordinary design. The factor $\left(\frac{\tau}{a}\right)^2 K$ with which the orthodox formula must be multiplied then becomes approximately 1.25 (1.9 to 4.0) for large machines and 1.25 (5.2 to 8.7) for small machines, or from 2.3 to 5.0 and from 6.5 to 11.0, respectively. These values check fairly well with those given by Prof. Arnold as derived from actual tests: 2.4 to 3.0 for large machines carefully constructed, 6 to 9 for average sizes and conditions, and from 12 to 18 for small machines and poor conditions. The latter values, however, include the additional losses previously mentioned.

To extend the comparison still further, it will be of value to have some idea concerning the size of these losses. As already described, the additional eddy current losses are produced partly in the pole faces and partly in the surface of the armature iron. Only the latter losses will be considered here. In the manufacture of the laminations, the punching process leaves more or less burrs on the outlines of the teeth and, after assembling the armature core, these burrs will bridge over the paper or paint insulation, which separates the individual punchings, thus forming a more or less coherent metallic stratum at the surface of the armature and the sides of the teeth, in which eddy currents can be produced to a greater or less extent unchecked by the insulation between the punchings. The turning of the armature and the filing of the slots has the effect of making the stratum a more perfect one. It is obvious that the seat of these losses must be mainly the tooth tip surface, because the density of the magnetic field is greatest here and the stratum is vertical to the direction of the flux.

Assuming that the loss is confined to the tooth tip surface proper, and that the surface itself consists of an even metallic coating of a definite thickness caused by the burrs, the following calculation can be made:

Let l = Armature length.
A_0 = Tooth width at top.
S = Thickness of coating at top of the teeth.
κ = Specific resist. per cubic centimeter.

Suppose the surface stratum $l\ A_0$ of the thickness S moves through the field, then the effective e. m. f. induced in the outermost eddy current path with the sides l and A_0 is $\frac{4\sqrt{2}}{10^8} b f l B_{tm} \sin\left(\frac{\pi}{4}\frac{\tau}{b}\right)$ in volts.

The e. m. f.s obviously decrease towards the center of the surface regularly and the mean square value is equal to

$$\frac{32}{3.10^{16}} (b f l B_{tm})^2 \sin^2\left(\frac{\pi}{4}\frac{\tau}{b}\right) \qquad (16)$$

The resistance of all the eddy current paths in parallel is $\frac{4\kappa l}{A_0}$ per cm thickness of the stratum, the small sides A_0 being neglected in comparison with the long sides l. The loss in the volume $A_0\, l\, S$ in watts is therefore:

$$\frac{8 l A_0 S}{3.10^{16}} (b f B_{tm})^2 \sin^2\left(\frac{\pi}{4}\frac{\tau}{b}\right) \qquad (17)$$

Introducing the value for the specific resistance κ of iron as 10^{-5} ohms per cubic cm, the loss in watts per cubic cm becomes

$$\frac{8}{3.10^{11}} (b f B_{tm})^2 \sin^2\left(\frac{\pi}{4}\frac{\tau}{b}\right)$$

As shown before, the sine can be superseded by the arc. After some transformations, the final results are:

$$W = \frac{\pi^2}{60}\left(\tau\frac{f}{100}\frac{B_{tm}}{1000}\right)^2 \qquad (18)$$

The relation between the two losses, the proper and the additional eddy current loss, can best be illustrated by calculations made on a 300-kw direct-current generator having the following constants:

frequency, $f = 9$
maximum tooth induction, $B_{tm} = 18{,}500$
armature length, $l = 25$
slot pitch, $\tau = 3.0$
tooth width $a = A_0 = 1.5$
tooth length, $l_t = 4.5$
thickness of laminations, $\Delta = .1$
coefficient, $K = 1.20$
thickness of surface coating, $S = .02$
number of teeth = 180.

All dimensions are given in centimeters.

From these data, the volume of the teeth is found to be 30,400 cu. cm and of the coating 135 cu. cm. The eddy current loss in the teeth in watts amounts to

$$1.2\frac{\pi^2}{60}\left(\frac{3.0}{1.5}\right)^2\left(\frac{9}{100}\cdot\frac{18500}{1000}\cdot .1\right)^2 30{,}400 = 660$$

and the loss in the surface coating to

$$\frac{\pi^2}{60}\left(3.0\frac{9}{100}\cdot\frac{18500}{1000}\right)^2 135 = 550$$

The above example shows that the analytical treatment of the surface losses fails to give a proof that the excess of eddy cur-

rent loss over that derived from the orthodox formula amounts to so much as to be accounted for by the surface losses alone. There must obviously be an inherent deficiency in the orthodox formula when applied to predetermine the eddy current losses in the teeth, which can be overcome by introducing two factors dependent upon the design of the armature and the poles. To take account of the surface losses a third factor c may be introduced varying roughly from 1.2 to 2.0, depending upon the quality of workmanship and the manufacturing process. The results arrived at by this reasoning are in very close agreement with the experimental data, and it is fair to assume that the proposed formula, for the watts per cubic cm.

$$W = \frac{\pi^2}{60}\left(\frac{\tau}{a}\right)^2\left[\frac{f}{100}\cdot\frac{Btm}{1000}\cdot\triangle\right]^2 K c \qquad (19)$$

where c varies from 1.2 to 2, will give a satisfactory approximation to the actual losses.

It is a well known fact that the iron losses increase with the load. This increase of the loss is almost entirely limited to the teeth. As far as the hysteresis loss is concerned, it is easy to calculate its increase, since it depends only upon the maximum values of the flux density in the teeth. The eddy current losses in the teeth, however, depend upon the maximum tooth density and the shape of the field curve. To take only the first value into consideration is obviously unsufficient. By resolving the field curve at no load and at any chosen load into the harmonics, considering only the first and the third harmonic fields, the values of the coefficient K at no load and any certain load can be found, and with them the ratio of the losses at no load and under load may be found as follows:

$$\frac{W_o \text{ under load}}{W_o, \text{ at no load}} = \frac{B^2tm, \text{ under load}}{B^2tm, \text{ at no load}} \times \frac{K, \text{ under load}}{K, \text{ at no load}}$$

Measurement of Wire and Cable Insulation.

BY TRACY D. WARING.

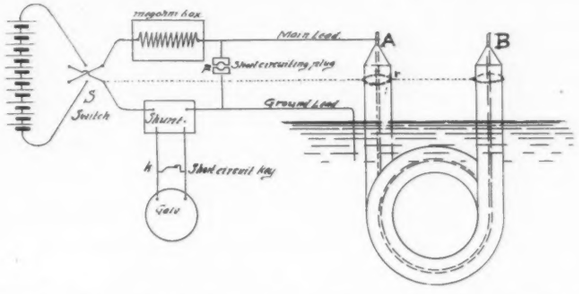
THERE appeared in ELECTRICAL WORLD of March 23, 1907, an article by Mr. F. Wachter entitled "Measurement of Wire and Cable Insulation." An editorial of the same issue very pertinently called into question the conclusions which Mr. Wachter draws from his observations, and in fact these conclusions are so at variance with the accepted notions, theoretical considerations, and experience of others, that it would seem far more probable that the results cited are to be attributed to errors in observation or some special circumstances pertaining to the method of testing than that the conclusion deduced should be correct—namely, that a long length of insulated wire will show under test an appreciably higher "insulation resistance per mile" than does a shorter length.

It was not to be expected that Mr. Wachter should enter into detail as to the precautions taken to guard against errors; and so far as his observations and conclusions are concerned, that question was beside the point, until his conclusions and observations had been challenged. On the other hand, a full understanding of every detail would be necessary to determine adequately or satisfactorily assure one's self, as to how to account for the results obtained.

The article has suggested, however, that some notes and comments on the errors to be guarded against and precautions to be taken in cable testing, should be of sufficient general interest to warrant the present writing.

We shall consider the insulation resistance test as usually made by applying a constant voltage between the conductor and the external conducting medium (generally water or lead sheath) and then measuring the leakage current thereby produced through the insulating wall of the cable. The leakage current is measured by the deflection of a sensitive galvanometer, and the deflection (which is a measure of the leakage current) compared with the deflection obtained through some standard resistance, say a megohm box.

Connections for this test are diagrammatically indicated in Fig. 1.



The guard ring and connections (shown dotted) are not an essential part of the apparatus. The galvanometer, short-circuit key (k) should be kept closed except when it is desired to take a galvanometer reading. If open at the moment of throwing on the battery, the galvanometer may be violently deflected by the charging current. The battery switch (s) is to be closed only during the time of test. As it is a reversing switch the battery may be thrown on in either direction. The galvanometer constant (deflection with one megohm in series) may be taken by short-circuiting across the lead wires with a plug at p.

FIG. 1.—CONNECTIONS FOR INSULATION-RESISTANCE TEST.

The chief sources of errors and discrepancies are generally attributable to, or can be accounted for, by proper consideration of, the following factors:

1°. (a) Leakage at ends of cable. (b) Leakage at battery. (c) Leakage on the lead wires or other parts of the system.

2°. Failure to properly measure leakage correction (if any) in leads and apparatus.

3°. Temperature of Cable.

4°. Duration of Electrification.

5°. Residual Charge.

6°. Galvanometer error (non-proportionality of deflection with current).

7°. Disturbances due to extraneous causes.

1°. Surface leakage at ends of cable (as does leakage in general) makes the measured insulation resistance (in megohm-miles) of the cable appear lower than it actually is, the shorter the length the lower the apparent insulation (in megohm-miles). It can best be avoided (and should be avoided) by having the ends thoroughly dry and clean. The insulation may to advantage (for careful work) be penciled down or scraped with a knife, but on no account should the ends be touched by the hand after cleaning and drying. If moisture is present it may be driven off by dipping the ends of the wire in hot paraffin or by pouring it over them. The use of a torch for drying is not to be recommended.

It is important to remember that every cable has at least two ends (a cable system may have many ends) each of them requiring equal consideration so far as leakage is concerned.

The "Guard Ring" method may be applied to cable testing for the elimination of surface leakage at the ends. The principle consists in providing an easy path for the surface leakage directly back to the battery so that it does not go through the galvanometer. The connections are indicated by dotted line in Fig. 1.

It is evident from Fig. 1 that any surface leakage from the end of the cable conductor from A over the surface will encounter the guard ring at r and will thence be carried directly back to the battery, and will not flow along the comparatively high resistance path to the water and thence through the galvanometer circuit, as would be the case if there were no guard ring connections.

The guard ring principle is of valuable application in testing the resistance of slabs of insulating material between plates, where the surface leakage is necessarily great as compared with the conduction through the insulating material; but its application to cable testing is hardly warranted on account of added complications to eliminate a difficulty which can, and should, be otherwise avoided.

(b). Battery leakage is an annoying source of trouble, and stray currents due to this cause seem sometimes, to the unwary, mysterious in their action, giving it may be a negative deflection. It can be eliminated by supporting the battery so as to thoroughly insulate it from the ground. This should be done in such a way as to insure perfect insulation for the battery under all atmospheric conditions. It is well to have the insulating supports readily accessible for cleaning.

It might also be mentioned that the precaution should also be taken of insulating the galvanometer, say for instance by placing it on hard rubber supports. The keys and switches and in fact all parts of the system should be so designed and arranged as to meet this requirement for high insulation resistance.

(c). To avoid the necessity of making correction for leaky leads, their insulation should be made as high as practicable. It is good practice for this purpose to support well insulated wires on a few good insulators, keeping the wires entirely free from all other contacts.

2°. While on the subject of lead wires it may be well to point out the proper method of correcting the galvanometer reading for faulty insulation or leakage in the leads or other parts of the apparatus. The *main lead alone* should be made free at the cable end and the deflection taken. This deflection is, of course, to be deducted from any reading obtained on the cable under test. The important point to be noted is, that the ground lead should not be disconnected from the ground (water or cable sheath) when measuring this correction for leakage. If the ground wire is also made free the resulting deflection will not be as great as it should be for the true correction.

3°. As is very well known the insulation resistance of a cable decreases as the temperature increases. In making any comparative test the importance of this factor is evident.

4°. The time (duration) of electrification of a cable under test is usually taken as one minute. The longer the voltage is applied the higher will be the measured resistance. This factor, if not considered, obviously leads to apparently very discordant results.

5°. Closely allied with the increase in insulation resistance due to duration of electrification is that of residual charge, and in experimental work it is perhaps the most difficult factor to contend with when aiming at just and accurate comparisons.

When a cable has once been tested it is impossible to repeat the test and get the same result until the cable has had time to thoroughly discharge itself. This may take many hours and by that time conditions which it was desired to keep constant may have changed, as for instance temperature, so that the gathering of accurate comparative data is rendered laborious and more dimcult.

The process of discharge, of the residual charge, may be partially assisted by charging the cable in the reverse direction to that of the original charge under test; but the only safe method seems to be to connect the conductor of the cable with the ground (*i. e.*, with the water or sheath) and await a sufficient time for the cable to recover its normal condition.

6°. It is generally assumed that the galvanometer deflection as read on the scale is proportional to the current passing through the galvanometer. With apparatus properly designed and properly erected this is true within all reasonable limits, but it is not to be assumed off-hand as though it were an inevitable law of nature true for all apparatus and for all conditions.

7°. Galvanometer disturbances from external mechanical causes, as vibrations or shocks, are of such apparent significance as to require only a passing mention, but it may happen that the operator himself is unwittingly a contributor to these disturbances if, for instance, the galvanometer has been mounted on the same table or bench as the keys which have to be manipulated during the test.

Other external causes of disturbance may be static charges, say, for instance, from belting adjacent to the leadwires; or disturbing currents may be induced in the leads or cable under test by adjacent wires carrying electric current; and in the testing of underground or submarine cable, earth currents often contribute their erratic and variable influence; even electrolytic polarization is a possible factor.

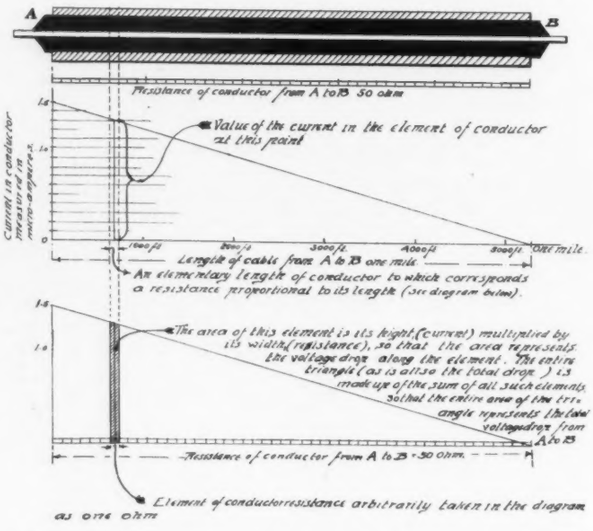
The sources of error just enumerated are perhaps sufficient to show that one must be very guarded in accepting or drawing general conclusions from a few tests made possibly under some special circumstances, perhaps inadvertently overlooked, and it would seem altogether probable that the results indicated by Mr. Wachter are to be accounted for on this ground rather than by the explanation which he suggests.

At any rate, as pointed out editorially, it is not difficult to show that his theoretical explanation as interpreted is quantitatively inadequate to account for the wide departure from the simple theory which his observations would indicate. Mr. Wachter's explanation appears to be based on two assumptions.

First, that the insulation resistance of a dielectric is different for different voltages; and second, that the drop in voltage along the conductor (due to the leakage current) is of sufficient magnitude to cause an appreciable effect on the test of a mile or less of cable.

The first assumption is contrary to general experience. Within at least a considerable range of voltage and for those dielectrics in common use for cable manufacture, the insulation resistance does not depend appreciably upon the impressed voltage.

The second assumption, as to drop in voltage along the conductor, may be treated as shown in Fig. 2, which represents


A
B
Resistance of conductor from A to B 50 ohm
Value of the current in the element of conductor at this point
Current in conductor in micro-amperes
1.5
1.0
0
1000 ft.
2000 ft.
3000 ft.
4000 ft.
5000 ft.
One mile.
Length of cable from A to B one mile.
An elementary length of conductor to which corresponds a resistance proportional to its length. (see diagram below).
The area of this element is its height (current) multiplied by its width (resistance), so that the area represents the voltage drop along the element. The entire triangle (as is also the total drop) is made up of the sum of all such elements, so that the entire area of the triangle represents the total voltage drop from A to B
Resistance of conductor from A to B = 50 ohm.
Element of conductor resistance arbitrarily taken in the diagram as one ohm

In order to be strictly accurate, in regard to unit area of the triangle representing unit voltage drop (say for instance one square inch representing one micro-volt), the two sides of the triangle should be drawn on the same scale. That is, the vertical side should be 1.5 inches long, and the base would have to be 50 inches in length; the actual area of the triangle would then be 37.5 square inches, representing 37.5 micro-volts.

FIG. 2.—REPRESENTATION OF ONE MILE OF CABLE.

one mile of cable having a measured insulation-resistance of, say, 100 megohms.

Let *A-B* Fig. 2 represent a length (say one mile) of insulated wire covered with a lead sheath or immersed in water with the ends free. In the cases cited by Mr. Wachter this would probably be a reel of insulated wire submerged in water.

Let us assume, so that the drop of voltage from *A* to *B* may be as great as possible, that the wire is a small one, say about No. 20 B. & S. G. copper wire having a resistance per mile of say 50 ohms. Also assume that the measured insulation resistance of this one mile length of cable is, say, 100 megohms and that we are using 150 volts (impressed at *A*) for our test

voltage. Then the value of the leakage current, all of which must pass through the conductor at *A*, is 100 meg-ohms.

$$\frac{150 \text{ volts}}{100 \text{ megohms}} = 1.5 \text{ micro-amperes}$$

This current, beginning at *A* with a value of 1.5 micro-amperes, leaks away from the wire through the insulating wall, the current in the wire growing less and less until the extreme end of the cable at *B* is reached where it reduces to zero. The current in the wire has thus gradually changed from 1.5 micro-amperes at *A*, to 0 amperes at *B;* and if the insulating qualities of the cable are fairly uniform, we shall make no appreciable error by assuming the decrease in value of the current to be uniform. This is represented diagrammatically in Fig. 2.

But what we want to find is the drop in voltage between *A* and *B* corresponding to this uniformly decreasing current in the wire, or in other words the total drop made up of the voltage drop in each elementary length of the wire, in which we may conceive the wire to be divided.

We may for convenience conceive that each of these little elementary lengths of wire are of equal length; each of these little lengths of wire will then have an equal resistance, and if we want to get the total drop in voltage along the wire from *A* to *B*, we may do so by multiplying the current value in each little length (beginning say at *A*) by its resistance, and adding these little products (or voltage drops) all up together as we proceed along the wire from *A* to *B*.

Consideration of Fig. 2 will show that this total sum is represented by the area of a right triangle having 50 ohms as base and 1.5 micro-amperes as side; that is, by

$$\tfrac{1}{2} \times 1.5 \text{ micro-amperes} \times 50 \text{ ohms} = 37.5 \text{ micro-volts},$$

which is the total drop in voltage along the conductor from *A* to *B*. We might at once have jumped at this conclusion by saying that the total drop is measured by the average or mean value of the current $\left(\frac{1.5+0}{2} \text{ micro-amperes}\right)$ multiplied by the total conductor resistance (50 ohms).

Returning now to the consideration of what effect this drop in voltage may have on our measured insulation resistance, at the end *A* we have applied for test purposes 150 volts between the conductor and the water or sheath. At *B* this voltage has only been reduced by 37.5 micro-volts, the remaining 149.9999625 volts being taken up by the drop through the insulating wall from the conductor to the water or sheath. It is of course inconceivable that the difference between 150 volts and 149.9999625 volts would have any measurable effect on the insulation resistance as measured.

Mr. Wachter concludes his article with a few words as to the practical importance of accuracy in insulation resistance measurements as an indication of the quality of insulated wire.

Insulation resistance (megohm-miles) is a factor the proper importance (or should I say unimportance) of which has only recently begun to be generally appreciated by practical men.

Insulated wires and cables are intended for conveying current along the conductor and resisting disruptive voltage stress through the insulation. There is no direct or necessary relation between "megohm-miles" and the disruptive voltage resisting qualities of a dielectric.

Of course, a definite kind, size and quality of insulated wire or cable should be expected to have a corresponding normal insulation resistance, but further than this the "megohm-miles" are of no practical importance as a criterion of serviceability.

I should like to say a word in regard to the expression "megohm-miles."

As properly stated in the editorial on Mr. Wachter's article, the expression "megohms per mile" as applied to insulation resistance of cables is illogical, inaccurate and misleading; so also is the expression "insulation resistance per mile." It may be slightly more cumbersome to say "insulation resistance of a mile length" or "insulation resistance of a mile," or perhaps "mile insulation resistance," but it is worth the gain in accuracy; and certainly the expression megohm-miles is accurate, more concise and equally euphonious as compared with "megohms per mile." In view of these facts why should we hesitate (when speaking of the insulation resistance of cables) to adopt the expression megohm-miles? It will cease to sound "pedantic" by use, but usage will never make the expression "megohms per mile" accurate, in the sense intended.

German Direct-Current Turbo-Alternator Plant.

An interesting steam turbine plant has been installed at the power house of the J. A. Maffei Locomotive Works, at Hirschau, Munich, in Bavaria, as shown in the accompanying illustrations. The steam turbine was built by Melms & Pfenniger, of München, and develops 1000 horsepower, being directly coupled to two 250-kw direct-current machines. The combined electric output of 500 kilowatts is lower than the most economical load for the 1000-hp turbine. The normal full load speed of this unit is 2459 r. p. m. During a test made by Prof. Schroeter with a steam consumption of 17.1 lbs. per kw-hour, the steam pressure was 176 lbs. per sq. in. above the atmosphere, the absolute steam pressure at the stop valves being 191.1 lbs., the actual steam temperature being 319.4 degrees C. (607 degrees F.) and with a vacuum of .484 lbs. per square inch absolute pressure.

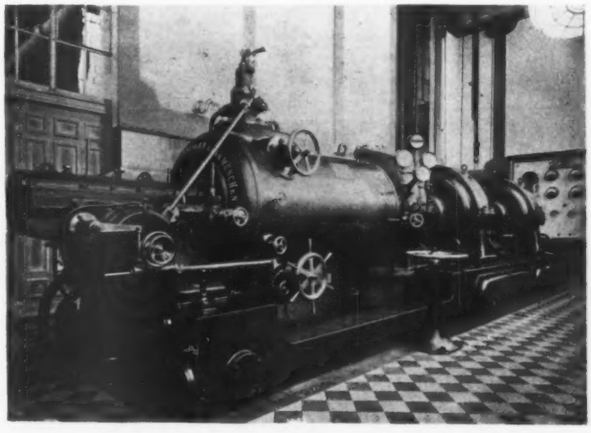


FIG. 1.—DIRECT-CURRENT 500-KW TURBO-GENERATOR INSTALLATION.

The design of this steam turbine was based on a combination of the action or impulse principle at the high pressure end of the machine and the reaction principle at the low pressure end, fixed guide blades being provided at the high pressure end with the admission of steam over only a small portion of the circumference, working on the partial admission method. The diameter of the drum is therefore large at the high pressure end, with a step-down for the beginning portion of the reaction part of the turbine.

It is maintained that the axial thrust of the steam due to the reaction part is balanced very simply on account of the annular surface formed in the above manner, while the length of the drum is much shorter on account of the introduction of this impulse principle in the construction, thereby reducing the cost of building considerably below that for the reaction turbine pure and simple.

It is also stated that less trouble is caused by the differences in temperature on account of the shorter casing required, with other advantages of reducing the number of rows of blades found necessary. It is held that the tests of Dr. Schroeter have shown this turbine to have a low steam consumption on account of the mixed type of construction. Even though the theoretical

efficiency of the reaction steam turbine is higher than the impulse turbine, as far as the friction losses are concerned in the absence of leakage losses, it is maintained that in practical operation at the high pressure end of the reaction turbine, this higher efficiency cannot be obtained, as the clearance which is required over the blade tips at this portion of the turbine result in large losses relatively by leakage, so that the use of the impulse principle in this particular portion of the steam turbine is a distinct gain. It is said that there is therefore not only a gain from low cost of construction but also a gain in economy by employing the mixed impulse and reaction principles in designing this turbine.

With the two electrical generators disconnected and the turbine running alone, the steam consumption was found to be 582 lbs. per hour, during the test above referred to, with a vacuum of .55 lbs. per square inch absolute pressure, and absolute steam pressure of 186 lbs. and actual steam temperature of 238 degrees C., the speed of the turbine being 2505. With the two dynamos connected and delivering a load of 400 kilowatts,

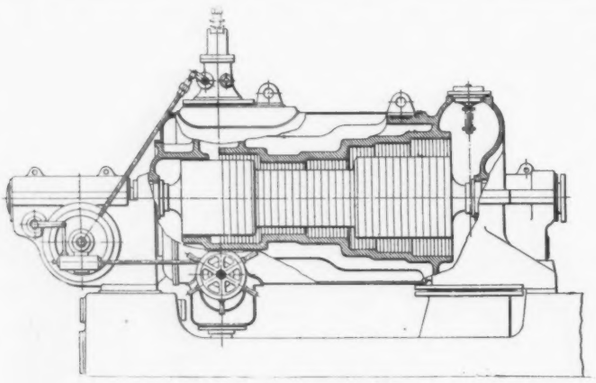


FIG. 2.—SECTIONAL ELEVATION OF STEAM TURBINE.

the steam consumption was 7055 lbs. per hour or 17.5 lbs. of steam per kw-hour. In this instance the speed of the turbine was 2469 revolutions per minute, the absolute steam pressure 189 pounds and the steam temperature 312.4 C. (594 degrees F.) while the vacuum was .43 lbs. per square inch absolute pressure.

On account of two dynamos being used instead of one there was undoubtedly high electrical losses as well as higher frictional losses than if a single generator had been employed. It is also held that the turbine was underloaded at 500 kilowatts when a steam consumption of 17.2 lbs. of steam per kw-hour was recorded, and that at 600 kilowatts output the machine would have shown a decreased consumption of about 16.6 lbs. per kw-hour.

It will be noted that the drum design is used even for the impulse section of the turbine instead of the multiple disk type usually employed for impulse turbines, and it is held that the losses from fluid friction is lower by this construction, as the drum exposes less surface than the disks. The German engineers also maintain that the simple method of balancing the axial thrust of the steam as used in this type of turbine is of much importance.

Copper-Graphite Brushes for Dynamos.

In order to improve the electrical conductivity of graphite brushes, Mr. C. W. Speirs, of London, England, according to a United States patent issued April 9, mixes with the plumbago copper in a finely-divided state. The proportion of copper is varied from point to point in the brush. For instance, that edge which first makes contact with any segment might contain, say, 60 per cent of copper, while that edge that breaks contacts can be without metal and the intervening portion can be graded in layers with varying quantities of metal. The graphite and metal having been mixed together and arranged in the desired manner the mass is subjected to a high pressure—say, from 15 to 30 tons per sq. in.—in order to effect the thorough union or solidification of the mass and so that any face or layer which consists exclusively of copper powder will form a continuous metallic space or layer in the compressed article. When the material is compressed, the flakes of graphite arrange themselves in stratified planes parallel with the pressing surface, so that a relatively large number of contacts between the flakes will occur in the length of the brush. Thus the longitudinal resistance of the brush is much greater than the transverse, so that there is a minimum of loss in the brush while the reversal of the current is greatly facilitated.

An Analysis of the Causes of Candle-Power Diminution in Frosted Lamps.

By Preston S. Millar.

In the Electrical World of March 17, 1906, was published an article by Messrs. Cravath and Lansingh, reporting upon tests of the "useful" or "80 per cent" life of frosted incandescent electric lamps. The results indicated the rate of candle-power diminution to be about twice as rapid as that of unfrosted lamps of the same type. The article raised a number of interesting questions and created considerable discussion both in this country and abroad. Following up the investigation, the writer has collected some data bearing upon the subject and presents them in the form of an analysis of the cause of the candle-power deterioration, endeavoring to locate with at least approximate accuracy, the extent to which the various factors contribute toward the net results. All data are obtained from tests of 16-cp, 3.1-watt carbon filament lamps tested at the Electrical Testing Laboratories. These tests include investigations of the following causes of candle-power deterioration:

First. Loss in candle-power due to increasing carbon deposit upon the inner surface of unfrosted lamp bulbs.

Second. *Increased* loss in candle-power due to the same carbon deposit upon the inner surface of *frosted* bulbs.

Third. Loss in candle-power due to dust and dirt upon the frosted surface.

The data on candle-power loss due to absorption by carbon deposit and to filament change in unfrosted lamps will be applied to frosted lamps. Warrant for this course lies in the fact that the resistance of the filament in unfrosted lamps varies throughout life substantially as does the resistance of the filament in frosted lamps. There is every reason to believe, therefore, that the filament change and resultant effects as determined in clear lamps may be applied without error in consideration of frosted lamp data.

Loss in Candle-Power Due to Blackening of Unfrosted Lamps.

The following lamps were selected for this test: Seven new lamps, 5 lamps whose candle-power had deteriorated 12 per cent during 324 hours of burning, and 12 lamps whose candle-power had deteriorated 20 per cent during 470 hours of burning.

The bulbs of these 24 lamps were removed from their mountings. A tubular lamp of suitable dimensions was procured. Determinations of mean horizontal candle-power were made with the tubular lamp alone and again when the tubular lamp was placed inside of each of the bulbs in turn. From the results may be determined the loss of light due to the absorption of the carbon deposit and the glass wall. By a comparison of the results obtained from the three groups of lamp bulbs the loss due to increased density of the carbon deposit may be determined.

This comparison is valid because later determinations made by cleaning both the new and old lamp bulbs demonstrated that the absorption of light by the glass alone was substantially constant when considering the mean of the values for the three groups of lamps.

An alternative method which suggests itself is that of comparing the old lamp bulbs before and after removing the deposit of carbon. Results obtained in this manner are likely to lead to improper conclusions as to the increased absorption

due to increasing deposit throughout life, because the bulb of the normal new lamp, which must be made the basis of comparison, already bears a slight coating of carbon, deposited during the manufacturing processes. A comparison made in this way would, therefore, lead to an exaggerated estimate of the deterioration in candle-power ascribable to increasing density of deposit.

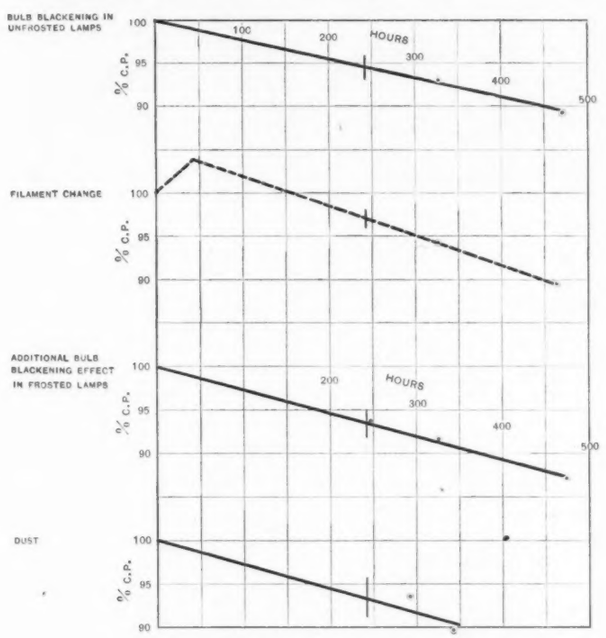
The investigation was confined to the horizontal plane for the reason that it is general practice to determine deterioration in candle-power by measurements of mean horizontal candle-power. We are, therefore, concerned more with the loss of light in the horizontal plane about the lamp than we are with the actual loss of light in all directions, as would be determined by measurements of mean spherical candle-power.

Average results obtained from these three groups of lamps by the method outlined are as follows:

Absorption of glass and deposit of new lamps	5.0%
" " " " " " 88% "	11.7%
" " " " " " 80% "	15.7%
Loss due to increased absorption at 324 hours	6.7%
" " " " " 470 "	10.7%

Deterioration in Candle-Power of Clear Bulb Lamps due to Changes in the Filament.

It having been shown that in certain instances the deterioration in candle-power due to increasing density of carbon deposit upon the inner surface of the globe amounted to 6.7 per cent at 324 hours, and to 10.7 per cent at 470 hours, it is assumed that all other deterioration not so explained is due to changes in the filament. The extent of such effects would then be 5.8 per cent at 324 hours and 10.5 per cent at 470 hours. These values are obtained by eliminating from a standard life test performance curve the effects shown to have been due to increasing absorption by the carbon deposit.



CANDLE-POWER DIMINUTION IN FROSTED LAMPS.

Loss in Candle-Power due to Increased Light Absorption by Carbon Deposit when the Bulb is Frosted.

The following method was adopted for determining this factor: Sixteen new clear lamps, 6 clear lamps whose candle-power had deteriorated 12 per cent in 324 hours of burning, and 10 clear lamps whose candle-power had deteriorated 20 per cent in 470 hours of burning, were selected. The mean spherical candle-power of each was determined. They were then acid frosted by the Sawyer-Man Electric Company, all under similar conditions, the lamps of each group being placed at one time in the same frosting rack, and the entire group being dipped as a unit. The results indicate the increased loss of light occasioned by the frosting upon the bulb of the two groups of lamps which had been burned for considerable periods.

Avg. Mean Spherical C.P. of 16 new lamps—clear	13.4
frosted	12.6
" " " " " 6 "88% lamps"—clear	11.6
frosted	9.95
" " " " " 10 "80% lamps"—clear	10.6
frosted	8.6
Loss of light occasioned by frosting—new lamps	6%
"88% lamps" (324 hrs.)	14.3%
"80% lamps" (470 hrs.)	18.9%

These data indicate a loss of 8.3 per cent at 324 hours and a loss of 12.9 per cent at 470 hours, due undoubtedly to the action of the increasingly dense carbon deposit in absorbing a gradually increasing proportion of the light which the frosted surface reflects and diffuses internally.

Loss in Candle-Power due to Dust on the Frosted Surface.

The only test of frosted lamps whose results are at the writer's disposal were made under conditions which made the soiling of the surface a factor to be considered. Consequently the lamp bulbs were not cleaned throughout the tests. Two tests of this kind may be referred to. In the first, 20 frosted lamps were burned for 290 hours, in the second, 7 frosted lamps were burned for 336 hours. The loss of light due to the dust upon the frosted surfaces is shown in the following statements:

FIRST GROUP.

Average mean spherical candle-power at end of test	9.83
after washing	10.74
Loss due to dust	6.7%

SECOND GROUP.

Average mean spherical candle-power at end of test	8.4
after washing	9.5
Loss due to dust	10.5%

It will be understood, of course, that this factor depends largely upon local conditions and varies with the length of time during which the lamp is exposed rather than with the hours burned. As in the case of both tests referred to, the relation between the time the lamp is exposed and the length of time burned is practically constant; the latter is used. Figures showing loss of light due to dust are to be understood as applying to the particular cases under consideration only.

Application.

The accompanying illustration shows the points determined by test and shows curves which the writer has ventured to draw in order to apply the results of the investigation to a test case. In accordance with the best information available, the "useful" or "80 per cent" life (20 per cent candle-power diminution from initial candle-power after frosting) of frosted lamps, when the bulbs are not cleaned during the test, is 240 hours. From the diagram, we derive the following factors as representative of conditions at 240 hours:

Cp diminution due to change in filament	2.9%
" " " " bulb blackening in unfrosted lamps	5.3%
" " " " additional absorption by deposit to which frosting subjects a portion of the light	6.5%
" " " " dust on surface of frosting	6.8%

That is to say, change in the filament is responsible for a decrease to 97.1 per cent of initial candle-power; the primary bulb blackening effect as in clear lamps further reduces the candle-power to 92.0 per cent of initial; the additional absorption to which the frosting subjects a portion of the light still further reduces the candle-power to 86.9 per cent of the initial value; and the dust factor occasions a final reduction to 80.1 per cent of initial.

These data are derived from independent tests made at intervals throughout a period of 18 months. Applied in this rather crude manner, they cover the situation so thoroughly that no doubt remains as to the validity of the explanation which they offer for the relatively rapid decline in candle-power of frosted bulb lamps.

Since writing the above, Dr. E. P. Hyde has published preliminary results of experiments conducted at the Bureau of Standards. It is interesting to note that Dr. Hyde's investigation along the same lines as part of the investigation reported above, yielded results of a similar character, differing only in degree from those obtained by the writer.

Lighting the "Greater Louisville" Exposition.

An exposition of products manufactured in Louisville, Ky., was held at the armory in that city March 18 to 30. The lighting was designed and under the charge of Mr. G. W. Hubley, director of power for the exposition. Mr. Hubley is superintendent and engineer of the Louisville Lighting Company. The accompanying illustration gives a good idea of the appearance of the armory while the exposition was in progress. The armory is 196 ft. x 270 ft. The principal lighting was by six-glower Nernst lamps hung about 22 ft. high. There were also some three-glower Nernst lamps placed 12 ft. high over the galleries. A few lamps placed very high near the roof served to light the decorations. There were in all 900 Nernst glowers. The power consumed for general lighting for the Nernst lamps was, therefore, about 1.6 watts per sq. ft. Besides the Nernst lamps there were five frosted 16-cp lamps on each booth arch. There were about 1500 of these arch lamps and about 1000 more incandescent lamps installed by individual exhibitors. The entire effect was good and can be taken as a criterion for the ample lighting of similar spaces elsewhere.

View of "Greater Louisville" Exposition.

New Telephone Patents.

NEW REPEATERS.

The telephone repeater is attracting more and more attention, little by little its difficulties are being overcome, and it would not be surprising if before long the use of the repeater will be commonplace. Of course, one of the greatest difficulties has always been in the necessity for reciprocal action, without introducing singing.

In Fig. 1 is shown a circuit patented by F. E. D'Humg, of Englewood, N. J., which seems to provide for the necessary requirements. The action hinges on the differential transformers t^{10} and t^{11} and upon the artificial lines A-A^1. A current coming from line C sets up currents in the local transformer circuit t^2 t^{10}, etc. The currents affect transformer t^{10} inductively and cause a movement of the transmitting parts at repeater R^2. The induced currents in t^{11} are of no effect in that transformer, because the current splits equally between its two branches. The equal splitting is caused by the equality of the two branches to earth. This equality is established by making the physical constants identical and by making the artificial line A^1 the equivalent of the real line C^1.

In a repeater and circuit patented by D. S. Dickerte, of Salt Lake City, an entirely different arrangement is made. The re-enforcing battery of each branch is in series in the line, and a portion of the circuit is formed by a receiving repeating coil primary and a microphone button in shunt. It is evident that with the button of high resistance much of the current passes through the coil and vice versa. Now, the parts are so related that the sending microphone is shunting out the receiving coil of its line section just when the repeater currents emerging from the microphone would produce the worst results in the receiving coil.

IMPROVEMENTS IN INSTRUMENTS.

In the line of simplifying manufacture, Mr. A. H. Weiss, of Chicago, has invented a pressed-sheet transmitter front which he has assigned to the Kellogg Switchboard and Supply Company. The disk is pressed into the usual shape for such parts,

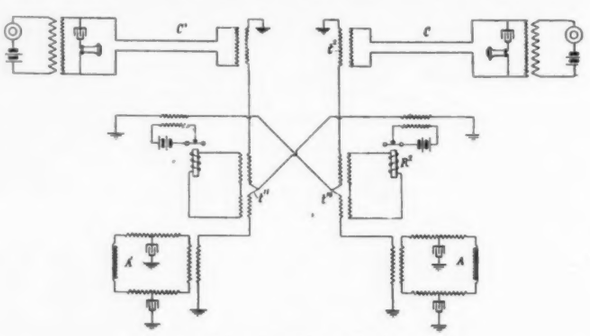


FIG. 1.—D'HUMG TELEPHONE REPEATER.

the edge of the mouthpiece opening being turned back inwards so that there is double thickness at the point where the threads must be cut to receive the mouthpiece. Again, short lengths of

FIG. 2.—WEISS TRANSMITTER FRONT.

the rear flange are bent inward into a plane parallel with the face, as required, to form seats for the bridge, etc. Fig. 2 shows the completed part in section.

Mr. A. Rector has devised and patented an auxiliary earpiece extension for receivers so that both ears may be used. There is provided a box-like part to be substituted for the cap, upon a receiver. This box carries a central axial tube from a side opening in which a flexible tube leads to the auxiliary earpiece. On the end of the box the regular cap is fitted. The axial tube is restricted just after passing the side tube, and there is therefore a forced distribution of the sound

effects. The tube flares from the narrow orifice and delivers directly into the aperture in the cap.

MISCELLANEOUS.

G. F. Atwood, of East Orange, N. J., is the patentee of a telephone set designed for use aboard ships. The door of the metal containing box may be unsealed from its seat by throwing wedge bolts. The door then swings back, exposing the hand microphone. The transmitter end is held in a tilting clamp, while the receiver end is locked fast by a spring latch. The latch projects through a sealed apparatus box within the main case, with which it has a water-tight joint. The latch serves as hook switch lever. The bell gongs are on top of the case, the hammer rod being carried through a water-tight shield. The telephone cord is reinforced by a steel guard so that a strong pull will not injure the cord. Mr. Atwood's patent is assigned to the Western Electric Company.

Frank M. Potter, Jr., of Rome, N. Y., has invented a hook-switch mechanism wherein the hook proper may be mounted on either side of the box at will, without any necessary readjustment of the springs or other parts.

A call register comprises the invention of C. T. Bradshaw, of Philadelphia. The register is operated from the central by a special key. The register will fail, however, unless mechanically released by the receiver being off the hook.

LETTERS TO THE EDITORS.

Measuring Insulation Resistance.

To the Editors of Electrical World:

SIRS: I should like to ask Mr. F. Wachter, the author of the article on "Insulation Measurements of Cables" printed in your issue of March 23, if he means to state that the $I\,R$ drop of the leakage current flowing through the line produces an actual drop in voltage at the end of the mile of wire he has under test. Also, if there is such a drop why he does not connect both ends of the wire to the battery. Also, why it is "obvious" that if the mile is to be taken as a unit, the reductions that he has shown should be made?

As the current flowing in the wire is of the order of micro-amperes and the testing battery is usually 100 volts and the resistance of the wire but a few ohms at most, it is easily seen that no ordinary instrument could detect the drop in voltage, which would not amount to .00001 volts. The descrepancies which he observes, I should suggest, were due to some of the many uncertainties of insulation measurements, among which are very large temperature coefficient, a variation in the rate of absorption and the variable amount of such absorption at the end of the usual 60 seconds electrification.

TRENTON, N. J. HARVEY S. PARDEE.

Rotary Converters vs. Motor Generators.

To the Editors of ELECTRICAL WORLD:

SIRS—It is too much to expect unanimous agreement with the conclusions pointed out in my discussion on "Synchronous Motors vs. Motor-Generators," which was read before the American Institute of Electrical Engineers on March 22. I am not surprised, therefore, to see the editorial in your issue of March 27 which expresses disagreement with the conclusions reached in the discussion referred to.

I wish to take this opportunity, however, to call attention to at least one fallacy upon which your disagreement to my conclusions is based. That fallacy is expressed in the following quotation from the editorial above referred to:

"The motor-generators gain materially from the fact that they can be designed with a much freer hand and worked nearer maximum efficiency without taking undue chances with the commutation."

As a matter of fact, ease in design, so far as commutation is concerned, lies with the synchronous converter and not with the motor-generator. One of the principal difficulties of the designer in direct-current design is to avoid the difficulties in commutation introduced by field distortion. The synchronous converter having no armature re-action has also practically no field distortion. This class of machinery, therefore, avoids one of the difficulties which the designer of the motor-generator must take into careful consideration in his work.

I might go on still further and give other reasons for not assenting to the position which you take editorially, but since it would be largely a repetition of the matter contained in my discussion, I do not consider that it is worth while to take further space in your valuable paper at this time. I am perfectly willing to stand by the conclusions which I pointed out in my discussion, and the reasons for holding these conclusions are, I believe, sufficiently set forth in that discussion.

PITTSBURG, PA. P. M. LINCOLN.

[Commutating difficulties may be due not alone to distortion of field but also, in the case of high-frequency high-voltage rotary converters, to excessive voltage between commutator bars necessarily narrow and to high peripheral speed. The fact that the sparking factor is an important one to be considered in direct-current design does not necessarily imply that it cannot be adequately provided for by the designer. In present-day practice, particularly since the advent of the commutating pole machine, sparking at the commutator is no longer the bug-bear it once was. In closing we may add that the best European practice quite contravenes our esteemed correspondent's views. —EDS.]

Calculation of Auxiliary-Pole Windings.

To the Editors of Electrical World:

SIRS: In your issue of March 30 Mr. R. B. Treat proposes to correct the expression for the frequency of commutation which was given in my article of March 9 as

$$f = \frac{b\,n}{120}$$

where b = number of commutator bars
n = r. p. m.

Mr. Treat's formula instead reads

$$f = \frac{\pi \times \text{commutator dia.} \times \text{r. p. m}}{120\ (\text{brush width} - \text{thickness of mica})}$$

or, neglecting the mica

$$f = \frac{\pi\,d\,n}{120\,w}$$

If the width of the brush is equal to the width of one commutator bar,

$$w = \frac{\pi\,d}{b}$$

which will make the frequency of commutation

$$f = \frac{b\,n}{120}$$

as used in my article.

If now the width of the brush is increased, say, doubled, for instance, the frequency of commutation will be halved and consequently the reactance voltage would also be half its former value. The number of coils short-circuited simultaneously has been doubled, however, giving approximately double the reactance voltage; that is, the two influences neutralize each other. Calling B the thickness of the com. bar + mica, and s the number of bars covered by brush the frequency of commutation may be expressed as

$$f = \frac{\pi\,d\,n}{120\,w} = \frac{B\,b\,n}{120\,w} = \frac{b\,n}{120\,s}$$

Substituting this value in formula (2) in my article of March 9 and introducing also the mutual inductions M of the coils short-circuited simultaneously with the coil under considera-

tion the exact formula for the reactance voltage would read

$$e = \frac{I}{2a} \times 2\pi \frac{bn}{120s} (L + \Sigma M)\ 10^{-8} \qquad (2a)$$

If a second coil short circuited simultaneously with the first coil under consideration is in the same slot, its reactance flux will be interlinked completely with the turns of the first coil and the mutual induction will be equal to the self-induction. If the two coils lay in adjacent slots, M will be somewhat smaller than L. There can, therefore, be substituted with reasonable accuracy

$$L + \Sigma M = s\,L$$

which will bring the formula (2a) back to its value given in my article of March 9:

$$e = \frac{I}{2a} \times 2\pi \frac{bn}{120} L\ 10^{-8}.$$

The error in Mr. Treat's suggestion lies, therefore in the fact that he neglects entirely the mutual induction of the coils undergoing commutation simultaneously with the coil in question. While the method proposed in my article of March 9 will lead to values slightly too high, Mr. Treat's formula will give values for the reactance voltage very much too low if the brush covers two or more bars.

This error is further brought out clearly in the numerical values calculated by Mr. Treat. For $b = 183$ and $T = 7$ he finds the necessary induction under the auxiliary pole to be $B = 842$ lines per sq. cm, while for $b = 61$ and $T = 21$ he finds $B = 2526$ lines; that is, three times the first value. Obviously the commutating field should remain approximately constant as long as the number of conductors on the armature is unchanged. The reactance voltage is proportional to $b\ T^2$ and the e. m. f. induced by the commutating field in the short-circuited coil is proportional to $B\ T$. As the two voltages must be equal, it follows that the induction, B, is proportional to $b\ T$; that is, the induction, B, remains the same as long as the product $b\ T$ is unchanged, no matter how the constituent factors of the product are changed.

According to Mr. Treat's formula, if on any particular machine the width of the carbon is doubled, the reactance voltage will thereby be reduced to one-half. Actual experience has shown, however, that this is not the case.

Pittsburg, Pa. Arthur Keller.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Transition Restistance of Carbon Brushes as Function of Temperature.—E. Arnold and E. Pfiffner.—To determine the influence of the temperature on the transition voltage of carbon brushes, Arnold has devised a special method of conducting the experiments. The results obtained show that to judge the quality of a material for dynamo brushes, it is important to test the influence of temperature. A proper cooling of the commutator and of the brushes is of great importance for producing good commutation. There is a distinct decrease of the transition losses with increasing temperature. If in the calculation of the transition losses the temperature is not taken into consideration, the calculated transition losses are too large. If the transition voltage decreases too much sparks may occur. This explains the well known phenomena that a machine may operate without sparks when cold and may begin to spark with increasing temperature, the sparks again raising the temperature, and so on. In the tests the commutator speed was 7.4 meters per second, the pressure of the brushes on the commutator was 160 grams per square centimeter. An important result is that the positive and the negative brushes if consisting of the same material behave in a different way. The positive brush (with the current flowing from metal to carbon) is less sensitive with respect to

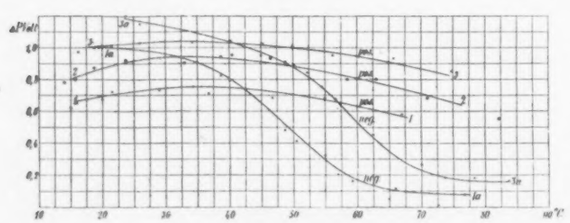


FIG. 1.—CURVES OF TESTS WITH CARBON BRUSHES.

temperature variations than the negative brush. Fig. 1 shows the results for a carbon brush made by the Le Carbone Company, type Z. The abscissæ give the temperature in degrees C. and the ordinates the transition resistance loss in volts. Curves 1, 2 and 3 give the results for the positive brush; 1*a* and 3*a* for the negative brush. Curves 1 and 1*a* refer to the current density of 2.5 ampere per square centimeter, 2 to the current density 5 amperes per square centimeter, and 3 and 3*a* to 10 amperes per square centimeter. Quite different are the results for the carbon brush "Morganite 2," shown in Fig. 2. The transition voltage of the negative brush is greater here for all temperatures than the transition voltage for the positive brush. But both types of brushes show the greater sensibility of the negative brush with respect to temperature changes. The authors remark that under difficult conditions of commutation it would be preferable to use, for instance, Carbone type Z for the posi-

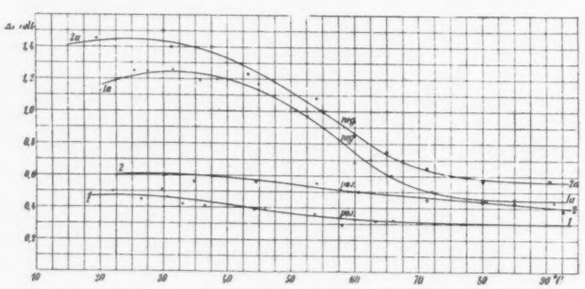


FIG. 2.—CURVES OF TESTS WITH MORGANITE BRUSHES.

tive brushes and Morganite 2 (Fig. 2) for the negative brushes. Tests were also made on the behavior of brushes at constant temperature, but with varying current density. The experiments were made with two different types of carbon brushes and the results show that the transition resistance in ohms as function of the current density is represented by a hyperbolic curve. Formulas are given for the transition resistance of these brushes. In making carbon brushes an endeavor should be made to produce a type which is as little sensitive as possible with respect to temperatures between 80 degrees and 100 degrees C.—*Elek. Zeit.*, March 21.

Magnetic Leakage in Induction Motors.—A. Baker and J. T. Irwin.—A paper describing experiments undertaken with a view to check the results arrived at by Behn-Eschenburg by entirely different methods, on the proper value to be assigned to the leakage factor of induction motors. The authors deal especially with slot leakage and with the value of the zig-zag leakage or winding coefficient. They conclude that Behn-Eschenburg's value for the latter coefficient should be multiplied by 4/3. Experiments are described in which the leakages were analyzed under certain conditions.—Lond. *Elec.*, March 29.

Air-Gap Ampere-Turns.—L. Legros.—First part of a mathematical paper on the predetermination of the air-gap magnetomotive force in electric machines.—*L'Eclairage Elec.*, Mar. 30.

Lamps and Lighting.

Wave Forms of Current and Cp of Alternating-Current Lamps.—J. SAHULKA.—An article referring to an instrument of Morris for measuring the instantaneous values of the candle-power of an alternating-current incandescent lamp. The method is based on the use of a disk on the axle of an alternator and the disk is provided with radial slits and the light of the lamp is thereby permitted to pass through one slit only at a certain moment in each period; that is, at a certain phase. The present author has formerly used a similar instrument with two parallel disks provided with slits, mounted on the axle of the synchronous motor. He also provided contact devices on this axle so that he could simultaneously determine the curves of current and e. m. f. By means of this apparatus it is, therefore, possible to find the curve representing the relation between cp and current. This curve he calls the light hysteresis curve. Another method is based on the following consideration: The instantaneous value of the cp of an alternating current incandescent lamp is not proportional to the simultaneous current, but depends only on the incandescent status of the filament and this corresponds to a certain definite resistance of the filament. Since the latter varies during each half period, the wave form of the current is distorted in comparison with the e. m. f. of the curve. With carbon filaments the resistance has a comparatively higher value when the current increases than when it decreases. For metallic filament lamps the reverse is true. The zero points of current and e. m. f. are the same. To obtain the wave form of the resistance of a lamp, the curves of current and e. m. f. may be determined and the resistance curve may then be found by simple division. After this has been done the cp corresponding to different values of the resistance may be photometrically determined with direct current. The resistance of the lamp is found from the readings of an ammeter and of a voltmeter connected in parallel. By means of a series rheostat the resistance of the lamp is adjusted so as to have the values in the resistance curve determined before, and for each of these values the cp is measured. In this way the curve form of the cp is obtained which corresponds to the alternating current. This second method was found to be inaccurate because the variations of resistance are very small even in the case of a metallic filament lamp.—*Elek. und Masch.*, Feb. 17.

Continuation.—In a continuation of these researches the author has succeeded in essentially improving the last named method (which he formerly found to be inaccurate). The improvement is due to the direct determination of the resistance curve (and not as before indirectly from the wave forms of the current and e. m. f.). The arrangement of the apparatus for the experiments is shown in Fig. 3. L is the lamp to be tested by

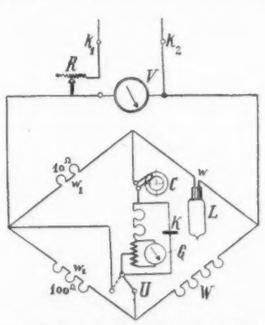


FIG. 3.—ARRANGEMENT OF APPARATUS.

means of a Wheatstone bridge. K_1 and K_2 are the connections to the alternating current supply line. W_1, W_2 and W are resistances. By means of the rheostat R the lamp L is brought to normal incandescence. The rheostat R must consume only a very small voltage since otherwise the variations of current and cp of the lamp would be diminished. During the test the voltage at the lamp must be kept constant; this is accomplished with a rheostat R with the aid of the voltmeter V. G is a sensitive mirror galvanometer of the Deprez type. C is the Joubert contact device driven by a synchronous motor. As in the determination of the curves of current and e. m. f., a large resistance is to be connected in series with the galvanometer and, in order to change the sensitiveness, an Ayrton shunt is provided. K is a condenser. The method of measurement consists in changing the resistance W until no current flows through the galvanometer G. The resistance of the lamp W is then equal to W multiplied by the ratio of W_1 to W_2. The brush of the con-

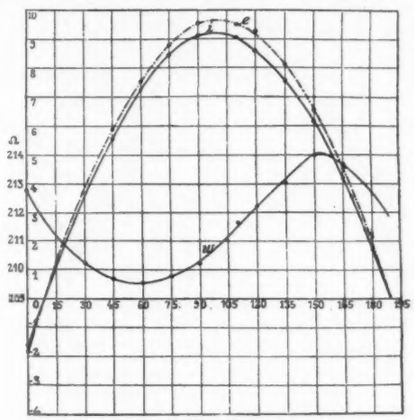


FIG. 4.—RESULTS OF TESTS.

tact device C is displaced from step to step and in each case the resistance of the lamp is measured. By measuring the cp of the lamp for different values of its resistance with direct current it is possible to determine the cp curve from the resistance curve. By means of the switch U it is possible to determine not only the resistance curve, but simultaneously the current curve. It will be seen from the figure that if the switch is turned to its second position the voltage difference at the terminals of the resistance W_1 in series with the lamp is measured and this is proportional to the current flowing through the lamp. This method was applied to tests of an osmin lamp of the Westinghouse Company which gave normally 58.9 hefner candles with a consumption of 58.2 watts at 110 volts. During the test the voltage at the terminals of the lamp was 116.5, the frequency was 50. The results are given in Fig. 4, which refers to a little more than half a period. The abscissæ give the phase angles, half a period being 180 degrees. The curve e is the voltage curve, I the current curve and w the resistance curve. The ordinates 0 to 10 represent "one unit" for i and "twenty units" for e and the ordinates 209 to 214 represent ohms. The resistance of the lamp varies only within the limits 209.6 and 214 ohms, *i. e.*, the maximum variation from the mean value is 2.1 per cent. On the

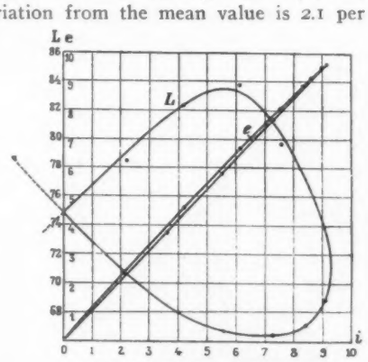


FIG. 5.—HYSTERESIS CURVES.

other hand, the maximum variation of the cp from the mean value amounts to 23 per cent. This variation depends, of course, on the material of the filament, on the frequency and on the voltage; it also must be larger for thin filaments than for thick filaments. It will be seen that the minimum and maximum of the resistance curve occur at entirely different moments than the maximum and minimum of the current and voltage curves. Fig. 5 shows two hysteresis curves for the same lamp. The narrow curve e relates to half a period, the current i being abscissæ and the corresponding voltage e being ordinates. While the

current increases the voltage passes through the lower branch of the curve; when the current decreases the voltage passes through the upper branch. In spite of the distortion of the current curve there is no phase difference between current and voltage. The product of the effective values of current and voltage is exactly equal to the power. The distortion of the current curve is simply due to the change in the ohmic resistance of the filament. The second hysteresis curve L also relates to one-half period, the abscissæ being again the current i and the ordinates (68 to 86) representing cp. When the current is zero, the cp is about at its mean value. With increasing current the cp decreases and reaches its minimum value when the current is about 75 per cent of the maximum value. This large displacement of the minimum of the cp is explained by the fact that during the preceding time interval the current is low and, therefore, the loss of heat much greater than the generation of heat from electrical energy. Near the minimum, the cp is almost constant for some time, because now the radiated and generated amounts of heat are about equal. When the current increases further, the cp increases, but when the current reaches its maximum the cp is still less than at the moment when the current is zero. The current now decreases, but the cp continues to rise rapidly and reaches a maximum. The current finally returns to its starting point on the axle of ordinates. The author finally describes in detail the apparatus used in his first method (mentioned in the preceding abstract) and points out some disadvantages in the similar method of Morris.—*Elek. und Masch.*, March 17.

Magnetite Arc Lamp.—W. Eminger.—The Siemens Brothers Company in Charlottenburg has patented a method of making magnetite electrodes from "oxygen compounds of iron" by fusing them with the electric arc and running the molten mass into iron tubes. The author has made a series of experiments with electrodes prepared in this way. He has tested pure magnetite (Fe_3O_4) electrodes, and also electrodes of magnetite with 15, 30, 50, 70 per cent rutile (TiO_2) and pure rutile electrodes. The magnetite used was about 91.1 per cent pure, the balance being oxides of aluminum, calcium, magnesium and silicon. An empty iron tube of 200 mm length, 14 mm internal diameter and ½ mm thickness of the walls, had a resistance of 0.00131 ohm. The voltage drop with 10 amperes was, therefore, 0.0131 volt. When the tube was filled with pure magnetite or with magnetite containing 50 per cent rutile, the voltage drop in the tube (while the lamp was lighted) was 0.0183 and 0.0200 respectively, the voltage drop in the filled iron tube while the lamp was lighted was, therefore, slightly larger than the voltage drop in the empty tube, but was still negligible. The increase of rutile increases the content of yellow and green rays in the light while simultaneously the chemically active rays are diminished. At the same time the volume of the arc gets smaller and the light cone gets sharper. It is very difficult to maintain a pure rutile arc for any length of time. Pure magnetite has a tendency to boil with resulting fluctuations of the arc. This may be avoided if the electrode is artificially cooled, for instance, by using a magnetite electrode with a copper core, the copper conducting the heat away. If this is done, magnetite electrodes without addition of titanium give good results. Magnetite (Fe_3O_4) is oxidized in the arc to (Fe_2O_3) while rutile is not changed. The final oxidation products are, therefore, not wholly or partially gaseous, but solid. The more rutile is contained in the electrodes the less is the development of smoke. The author calculates the theoretical quantities of air which are required per hour for a current of 8 amperes for the oxidation process, first for an ordinary arc lamp (59 liters), then for an enclosed arc (2 liters) and, finally, for a magnetite arc with positive copper electrode (0.023 liters). It would seem that the magnetite arc lamp could, therefore, be used almost under complete absence of air. But the considerable amount of smoke developed makes it necessary to carry it off with air so that an increased supply of air is necessary. With magnetite containing 50 per cent or more of rutile it is very difficult to start the arc between the magnetite and the copper electrode if the magnetite electrode is not preheated. It is, therefore, practicable to use less than 50 per cent of rutile. With a lamp with an electrode containing 70 per cent magnetite and 30 per cent rutile, consuming 7 amperes at 64 volts, the spherical candle-power was 834, hence the specific consumption was 0.537 watts per spherical (hefner) candle. For an arc length of 15 mm. the lower hemispherical candle-power and the specific power consumption were found to have the following values for magnetite electrodes containing different percentages of rutile:

	volts.	amperes.	watts.	candles.	watts per cp.
15 per cent Ti O_2.....	60.24	8.75	527	711	0.71
30 " " "	61.6	8.4	517	815	0.634
50 " " "	63.96	8.54	546	1000	0.546

For varying arc length, but constant current, the lower hemispherical candle-power and the watts per candle-power have the following values, a magnetite electrode with 30 per cent Ti O_2 being used.

arc length	volts	amps	watts	candles	watts per cp
10	52.75	9.58	504	743	0.673
15	63.5	9.75	620	1062	0.581
20	71.0	9.75	694	1345	0.515

Finally the influence of both the arc length and the current on the watts per lower hemispherical candle-power is given in the following table:

arc length in mm.	3 amp.	5 amp.	6 amp.	8 amp.	10 amp.
			15 per cent Ti O_2		
5	1.58	0.95	0.85	0.80	0.76
10	1.02	0.6	0.51	0.46	0.41
15			0.4	0.38	0.34
20					0.28
			30 per cent Ti O_2		
15	0.72	0.41	0.36	0.34	0.32
20				0.3	0.25

For constant current the specific consumption in watts per lower hemispherical candle-power decreases with increasing arc length. For constant arc length the specific consumption decreases rapidly with increasing current between 3 amperes and 6 amperes, but when the current increases above 6 amperes, the decrease of the specific consumption is very slight. The specific consumption remains then almost constant. On account of the light sent upwards from a magnetite arc lamp, a reflector must be used. All the above figures relate to measurements of the power in the lamp itself, not including any series resistance. The intensity of the light is a maximum within the horizontal. Electrodes containing 30 per cent of rutile are consumed somewhat more quickly than pure magnetite electrodes. The consumption of an electrode containing 30 per cent rutile was 1.05 mm at 6 amperes, 1.65 mm at 8 amperes and 2.14 mm at 9 amperes per hour. Some figures are given on first cost and cost of maintenance of magnetite electrodes.—*Dingler's Polyt. Jour.*, Jan. 5 and 12, abstracted in *Elek. Zeit.*, March 21.

Arc Lamp.—A. Blondel.—An account of a recent (British) patent for an enclosed flame-arc lamp. Hitherto impregnated carbons could not be used in enclosed arc lamps on account of the combustion gases and smoke developed. The principle of the present invention is such a construction of the lamp that by natural or forced draft the combustion gases and smoke are quickly carried off into a condensing chamber where they are partly deposited. The purified gases are returned to the proximity of the arc. A very limited circulation of impure gases within the globe is the feature of the construction. The combustion of the carbon is thus reduced from the beginning even if the arc is very large. The patent is reprinted in full, with illustrations.—Lond. *Elec. Eng'ing*, March 21.

Arc Lamps.—B. Duschnitz.—A useful illustrated review of recent inventions in the construction of arc lamps. The descriptions are mostly abstracts of recent German patent specifications. The different improvements dealt with relate to the regulating mechanism of the arc lamp, the composition of the carbon electrodes and devices for extinguishing the arc. Many of the inventions described relate to flame-arc lamps.—*Elek. Anz.*, March 3, 14 and 17.

Tungsten Lamp.—An account of a recent British patent granted to the Consortium f. Elektrochem. Industrie of Nurem-

burg, Germany. A tungsten filament before being used for lighting is raised in vacuuo or in an indifferent atmosphere to a very high temperature, almost as high as its melting point. For instance, a tungsten filament which is to be used subsequently at the specific consumption of 1.5 watt per candle should be electrically heated with at least one watt per candle. The result of this treatment is that the filament becomes practically constant as regards its electrical properties, for instance, for a load of from 1 to 1.5 per cp. This effect is explained as the result of the filament giving off all its impurities at the high temperature and becoming denser.—Lond. *Elec. Eng'ing,* March 21.

Tungsten Lamp.—A. BAINVILLE.—A lecture before the Society of Electricians in Paris on the tungsten lamp. The author gives a review of what has been published concerning this lamp in the past, but does not seem to give anything new.—*L'Ind. Elec.,* March 10.

Osram Lamp.—According to an advertisement of the German Welsbach Company, the osram lamp is made for e. m. f.s from 100 to 130 volts, and for candle-powers of 32, 50 and 100 hefner candles. "We are now in a position to supply the osram lamp promptly even in larger quantities." Extracts are given from the report of the Reichsanstalt on tests of eight lamps which has already been noticed in the Digest.—*Elek. Zeit.,* March 21.

Power.

British Power Company.—A note stating that up to the present time the Newcastle-on-Tyne Electric Supply Company has been the most successful company in carrying out a bulk supply of electrical energy. At the last annual meeting it was announced that 16,700 hp had been connected to the mains during the year, making a total of 70,000 hp. The total revenue for the year was $884,050, of which only about one-fifth was received from lighting consumers, so that the output is mainly for motors. It is impossible to give the actual revenue per unit sold, as in a number of cases no meters are used; but, notwithstanding the large amount of energy sold at less than 2 cents per unit, the profit amounted to $428,735 and the ordinary shares received a dividend of 8 per cent. The favorable result is due to the progressive policy of the company in pushing out its feeders in all directions and to an excellent commercial management.—Lond. *Elec.,* March 22.

Electric Power in Briquet Factory.—KRUMBIEGEL.—An illustrated description of electric power applications in the lignite briquet factory in Lanchhammer, in Germany. With the exception of the presses, all of the machines are provided with individual motors.—*Elek. Kraftb. u. Bahnen,* Feb. 14.

Traction.

Electrification of Steam Railways.—An annoymous article, "by a railway engineer," on the best system for electrifying steam railways from the operating point of view. The author takes the view that as regards ease of operation the third-rail system is much to be preferred to the newer single-phase overhead system which is now receiving so much attention. He is also of the opinion that the saving in capital cost by the latter is overrated.—Lond. *Elec.,* March 29.

Single-Phase Motor.—W. REICHEL.—A fully illustrated description of a 350-hp single-phase traction motor for a frequency of 25. It is built by the Allgem. Elek. Ges. and is of the Winter-Eichberg type.—*Elek. Kraftb. u. Bahnen.,* Feb. 4.

Transportable Transformer Station.—E. CSERHATI.—An illustrated description of a transportable transformer station of 430 kilovolt ampere capacity, placed on a car and used on the Veltellina Railroad.—*Elek. Zeit.,* March 21.

Berlin Sub-Station.—C. HEILFRON.—A fully illustrated description of the Bismarckstrasse sub-station of the Berlin electric elevated and subway. When fully completed it will supply 2700 kw for traction. Electrical energy is furnished to the substation in form of three-phase currents at 10,000 volts, 40 periods. In five transformers the voltage is reduced and the alternating current is then changed in five 660-kw synchronous converters into direct current at 750 volts.—*Elek. Kraftb. u. Bahnen,* March 14 and 23.

Dublin.—The annual report of the Dublin United Tramways Company for 1906. The parcel traffic has become an important source of revenue. The number of passengers carried was 51,512,995, the car-miles run 7,389,576. The total expenses per car-mile were 9.910 cents. The total receipts 17.86 cents, hence the balance per car-mile 8.07 cents.—Lond. *Elec.,* March 22.

Electro-Physics and Magnetism.

Paraffined Paper Condensers.—A. L. DEARLOVE AND R. M. SAYERS.—An article giving in diagrams and a table the results of tests as to the influence of temperature on the dielectric resistance of paraffined paper condensers.—Lond. *Elec. Eng'ing,* March 21.

Condensers.—F. T. TROUTON AND S. RUSS.—An abstract of a (British) Physical Society paper on the rate of recovery of residual charges in electric condensers together with abstract of the discussion which followed its reading.—Lond. *Elec.,* March 22.

Selenium.—A. POCHETTINO AND G. C. TRABACCHI.—An account of experiments on the behavior of selenium cells, prepared in different ways, towards alternating currents.—*Il Nouvo Cimento,* Dec., 1906; Lond. *Elec.,* March 22.

Electrochemistry and Batteries.

Magnetic Concentration.—P. MCN. BENNIE.—A fully illustrated description of the Gröndal process for magnetic separation of iron ore. The ore is crushed dry to about one-half inch cube. This is followed by wet treatment in a ball mill which reduces the size to from 10 to 100 mesh. The ground pulp is then passed through a Gröndal magnetic separator whereby the non-magnetic particles are removed. The concentrates are pressed into briquets and heated in the Gröndal briquetting kiln without any binder. They issue from the kiln as hard, porous, easily reducible ferric oxide briquets, with a minimum percentage of sulphur. The process is in successful use in Norway and the author thinks that it should also have a field in Canada.—*Electrochem. and Met. Ind.,* April.

Electrolytic Alkali and Bleach Industry.—J. B. C. KERSHAW.—An abstract of a Faraday Society paper giving statistical data on the present situation of the electrolytic alkali and bleach industry. There are now 27 electrolytic works in operation in the world, employing 54,700 horse-power, and with plant of about 13,000 hp lying in reserve. Some notes are also given of what the author thinks will be the future of the alkali industry.—Lond. *Elec.,* March 22.

Units, Measurements and Instruments.

Galvanometer.—J. K. A. W. SALOMONSON.—Einthoven has recently described a highly sensitive galvanometer in which a thin silver-plated thread of quartz was tightened like a violin string in a magnetic field. The distortion of the thread due to the passage of current was observed with the aid of a microscope. T. Place has made experiments with a modification of this instrument in which the magnetic field was produced not by a magnet or an electromagnet, but by two parallel wires carrying current. The thin thread was also distorted in this case on account of the electrodynamic attraction or repulsion from the two parallel wires. The author has constructed an exact instrument based on this principle. It may be used as galvanometer, as an electrodynamometer, a wattmeter or as an electrometer. The construction is described, and some results obtained with it are given.—*Phys. Zeit.,* April 1.

Electric Thermometer for Medical Purposes.—A note on an electric resistance thermometer specially adapted for the graphic representation of the temperature of feverish patients with an accuracy of 0.1 degree. A resistance thermometer, consisting of a wire or strip-shaped conductor wound on a copper plate and covered with a thin silver shell, is connected by a twin flexible conductor to a registering apparatus constructed on the ohmmeter principle. The sensitiveness is such that a movement of 1 mm of the needle indicates a change in temperature of one-tenth of a degree. As the working power is too small to allow of ordinary methods of registration being used, the pointer is fitted with a silver pin which is pressed on the prepared surface of a revolving drum. Pure platinum is the best metal to use for

the cap of the instrument, which is placed directly against the armpit of the patient, as it possesses the great advantage of a constant temperature coefficient.—Lond. *Elec.*, March 29.

Mutual Inductance.—Rosa and Cohen.—Two mathematical papers. In the first, by Rosa, the formula of Weinstein and Stefan for the mutual inductance of coaxial coils of rectangular cross-section are critically examined and compared with each other. In the second paper, by Rosa and Cohen, the various formulas for the mutual inductance of two circular coaxial coils of rectangular section are examined and compared by numerical calculations.—*Bull. of the Bureau of Standards*, Vol. II, No. 3.

Photometry of Lamps of Different Colors.—P. Lauriol.—An article showing the inherent impossibility of comparing in general two sources of light of different spectral composition. The author discusses limiting conditions under which photometric measurements such lamps might be possible.—*L'Ind. Elec.*, March 10.

Photometer.—E. Pressner.—An article giving some notes on the theory of the Ulbricht sphere for determining the mean spherical or hemispherical candle-power by a single measurement. It is pointed out that the "constant" coefficient which enters into all results depends greatly on the uniformity and constancy of the white color of the internal reflecting walls of the sphere. Any dirt which might settle on the walls is a greatly disturbing factor. The author prefers to paint the internal walls with a gray color.—*Elek. Anz.*, March 3.

Telegraphy, Telephony and Signals.

Telegraphy in India.—C. T. Williams.—An article on the Baudot telegraph system in India where it is doing excellent work. It has been employed to a large extent before in Continental Europe. Some details are given on the equipment of the system.—Lond. *Elec.*, March 22.

Wireless Telegraphy in a Certain Direction.—K. Uller.—The author refers to Fleming's theory of Marconi's method of sending wireless telegrams in a certain direction by employing a bent antenna. The present author criticizes some points of Fleming's theory which he does not believe is confirmed by the experiments referred to by Fleming.—*Phys. Zeit.*, April 1.

Undamped Electric Oscillations.—Sahulka.—An illustrated article giving a simple explanation of the production of undamped oscillations with the aid of the Duddell-Poulsen arc-lamp method.—*Elek. und Masch.*, Feb. 3.

Telephone.—Poincare.—A continuation and conclusion of his highly mathematical paper on the theory of the telephone receiver.—*L'Eclairage Elec.*, March 16 and 23.

Railway Signals.—Peter.—An illustrated article on power signalling as installed by the Underground Electric Railways Company of London.—Lond. *Elec. Rev.*, March 15, 22.

BOOK REVIEWS.

Elektrischer Energie. "The Selling Price of Electric Power." Die Preisstellung bein Verkaufe. By Gustav Siegel. Berlin: Julius Springer. 192 pages, illustrated. Price, 4 marks.

The author has presented in this little volume a doctorate thesis on the cost and selling prices of electric power in different countries and cities, but particularly in Germany and in German cities. The data set forth have principally been taken from books and electrotechnical periodicals. Comparatively few curves or graphic tabulations are offered in the text. The book will be mainly of interest to those who study electric power distribution in German cities.

The Practical Testing of Dynamos and Motors. By Charles F. Smith. Manchester: The Scientific Publishing Company. 306 pages, 108 illustrations. Price, 5 shillings.

This book of about 250 pages is intended, in the words of the author, "to serve as an elementary introduction to the testing of continuous current dynamo machinery," and will be of use to the practical man who is too practical to be satisfied with information and rules obtained at second hand, but who wishes to convince himself by actual trial of the truth of what he is told. The book is further intended for the use of students as a guide to elementary experimental work in connection with the testing of continuous-current machinery.

After a few general hints on the precautions to be observed in obtaining accurate results, a preliminary discussion is given of the laws of electricity and magnetism upon which the design and operation of electrical machinery are based. The production of e. m. f. in a dynamo is then taken up, leading to the effects of armature reactions on regulation and commutation. The author then proceeds to describe a series of experiments or tests illustrating very fully the characteristics of the principal types of machines, including separate, series, shunt and compound-wound dynamos and motors, boosters, motor-generators and balancers.

In all cases the theory and an explanation of the purposes of the test are given, as well as directions for connecting up the necessary apparatus and a list of the observations to be taken. Results of actual tests are given in the form of curves and the shape and peculiarities of these curves are discussed in such a way as to familiarize the student with the various characteristics of the various types of direct current machinery in common use. Towards the end of the book a chapter is devoted to "Miscellaneous Tests" comprising the measurement of insulation resistance, distribution of potential around the commutator and the effect of brush position on motor operation.

Throughout the book it is evident that the intention of the author has not been to go into the subject mathematically, but rather to give junior students a clear physical conception of what is happening in a machine under various conditions of operation, without the use of any mathematics other than the most elementary algebra and geometry.

Ice Formation. With Special Reference to Anchor Ice and Frazil. By Howard T. Barnes. New York: John Wiley & Sons. 257 pages, 40 illustrations. Price, cloth, $3.

This book gives the ice story of the mighty St. Lawrence River. It contains the results of the author's observations and experiments, some of which have been published from time to time in scientific periodicals. The effects of the severe Canadian winters on such a large river as the St. Lawrence afforded splendid opportunities for the study of ice formation, especially in connection with its effect on hydraulic developments in northern climates.

The first chapters of the book deal with the physical laws governing the transfer of heat, the physical constants of ice and the formation and structure of ice. These are preliminary to the main features of the book, which brings out the conditions governing the formation and disintegration of frazil and anchor-ice. These are deduced from experiments and measurements of the temperature of the water during the winter by means of delicate resistance thermometers. Precise temperature measurements and river temperatures are dealt with in two chapters. It is shown by experiments carried out by the author and recorded in the book, that a river never differs more than a small fraction of a degree from the freezing point during the winter, and that the growth of ice is accompanied by a minute temperature depression in the water of the order of .01 degree Fahrenheit.

A chapter on sheet, frazil and anchor-ice sets forth the reasons for distinguishing between these three forms of river ice. A chapter on theories to account for frazil and anchor-ice illustrates the need for some terminology to describe and correlate the observations of numerous writers on this subject. The final chapter on methods of overcoming the ice problem in engineering work describes preventive measures which have been adopted.

Three forms of ice are found in the St. Lawrence in winter, sheet or surface ice, frazil and anchor-ice. These the author explains differ in their mode of formation, their general appearance, the position they occupy in the river and the effects which they produce.

Sheet-ice forms over the surface of quiet water from the banks

toward the deeper portions by the direct contact of a cold atmosphere. Once formed it increases slowly in thickness by conduction of heat from the water through the ice and by accumulation of snow and frozen rain.

Frazil-ice is a fine specular-ice formed on the surface in open channels where the current is too rapid for the border-ice to extend across. It sometimes appears as "plate-ice" on the smooth surface of a current, or as a numberless minute needle crystals in rapids or at the base of water falls. Frazil-ice, it is explained, is the result of surface cooling of the water in contact with a cold atmosphere. The fine needle crystals once formed increase in bulk by slow, continuous freezing and form spongy masses, being very troublesome, as in this agglomerate state they freeze to any object immersed in the water. When carried under surface ice they become attached to it and are liable to dam up channels completely.

Anchor-ice, or ground-ice as it is called in England and grundeis in Germany and glace-du-fond in France, is ice which grows *in situ* on the bed of a river which flows too swiftly for surface-ice to form; it grows upward in long needle crystals which ramify and divide, covering the bottom very much as the weeds do in summer, and the long tentacles thrust upwards and attach the frazil-ice.

Frazil-ice and anchor-ice are the cause of winter and spring floods. To prevent the stoppage of power plants the author describes successful methods of placing the racks and wheels under shelter and applying artificial heat to keep the metal from becoming supercooled in winter.

The general treatment of ice formation in rivers is taken from a scientific standpoint and a study of this book will guide in the treatment of individual cases where the ice problem is involved. The book should prove of great value to the engineers in general and specially to those directly engaged in hydraulic development in northern climes.

Motor Drive for an Alaskan Gold Dredge.

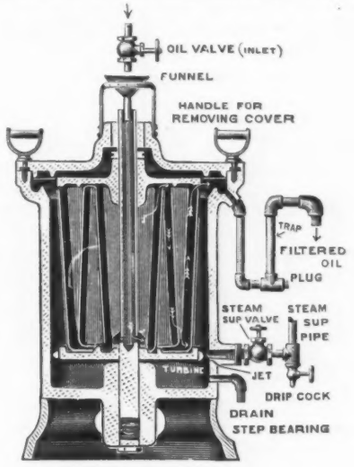
The Bonanza Basin Gold Dredging Company which has been operating during the past years in the Bonanza Basin district of Alaska, with steam-driven gold dredges of Allis-Chalmers and other designs made arrangements recently for obtaining a supply of electrical energy from the Dawson Electric Light & Power Company, of Dawson City. In order to take advantage of the electric power which is now available the dredging company has ordered the alteration of the big Allis-Chalmers dredge, which is the "sluice type," steam driven, to the "stacker type" electrically driven. This alteration necessitates the use of separate motors for each specific drive throughout the dredge, in addition to the substitution of new winches and gravel handling devices required by the change from sluice to stacker type. The current to be used will be alternating, three-phase, 60-cycle, 2300-volts.

The motor equipment, of same manufacture, will be made up as follows: The bucket drive motor will be 100 hp, 2300 volts for variable speed and reversing. A 50-hp constant speed, 2300-volt motor will drive 12-in. pump. Two variable speed 30-hp, 440-volt machines will drive the main and ladder winches. A 15-hp constant speed, 440-volt motor operating at a speed of 1130 r. p. m. will operate the screen and stacker hoist. The stacker will be driven by means of a constant speed motor, 15-hp, 440 volts. A 3-in. primer pump will be driven from a 10 hp constant speed machine. The stacker for this dredge will have 80-ft. centers and a belt 30 ins. wide, driven from the top end by a motor.

Turbine Centrifugal Oil Filter.

The Oil and Waste Saving Machine Company, of Philadelphia, is manufacturing a turbine centrifugal oil filter constructed on a new principle for cleaning oil. It is operated by a steam turbine, which requires no care except to turn the steam on and off. The oil is run into the filter through the shaft of the turbine, while in operation. It is then sprayed on to the filtering cloth and filter paper, revolved by the turbine. The centrifugal motion carries the oil through the filtering materials, over the cones, to the outlet.

The oil passes through clean filtering material continually for the reason that as soon as the filtering materials become dirty or



CENTRIFUGAL OIL FILTER.

dammed up at the point where the first exposure occurs, or near the spray, it then takes a new course through the clean filtering materials. This is an advantage, as in older methods the filtering materials are all exposed to the dirt in the oil at once.

The filter can be taken apart in a few minutes and the filtering materials cleaned and used over and over again, with the exception of the paper through which the oil passes. This is so cheap, it is not worth using again.

Electrically-Driven Paper Mill in Japan.

Representatives of the Oji Paper Company, of Tokio, Japan, have for some time been inspecting various electrical properties in the United States with an eye to installing a modern electrically equipped paper mill in Japan. As a result of their investigations, orders have been placed in the United States for a very complete electrical and mechanical equipment amounting to over a million dollars.

At the power station there will be installed four water-wheel driven three-phase, 3125 kva units, generating current at a potential of 3450 volts, at a frequency of 60 cycles. Power for exciting the revolving fields of these generators will be furnished by the usual twin exciting units, consisting of two 150-kw generators, driven respectively by an induction motor and a small water wheel. Generator regulation will be affected by a Tirrill regulator. Twelve water-cooled, step-up transformers will be arranged in sets of three to raise the voltage for a 15-mile transmission. Each transformer will have a capacity of 1050 kw and the primary voltages will be arranged with Y connections for either 46,000 volts, 45,000 volts or 44,000 volts. An eight-panel switchboard embodying the standard practice of the General Electric Company will be installed in the main station. At the sub-station near the mill, 12 step-down transformers will be employed to reduce the transmitting potential to 2200 or 2100 volts. The switchboard will be arranged to distribute power at the desired voltage directly to the motors.

In the paper mill five 750-hp, 2000-volt induction motors will be used to drive the pulp grinders. These motors have an external resistance in the armature circuit and controllers to vary the speed. Each motor will have an extended shaft and will be so placed between two pulp grinders that both grinders can be driven directly without belting. Four beater machines are to be driven, each by a 350-hp induction motor operating at a potential of 2000 volts. A fifth will be driven by a 200-hp induction motor and all will be operated on the rope drive system. The Oji paper mill will be situated at Hokaido.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade were rather irregular, due to the erratic weather, retail sales of Spring wearing apparel being retarded by storms and cold weather at many points. In some sections, however, seasonable conditions were experienced. The volume of business transacted, on the whole, exceeds that of the corresponding period of other years. The temporary interruption to retail distribution by the weather had no ill effect upon jobbing and wholesale business, heavy transactions and shipments testifying to confidence in the future, while mercantile collections show further improvement. Several strikes have retarded work, notably in sawmills at Portland, Ore., and in shipbuilding at Cleveland, but manufacturing returns are most satisfactory on the whole. Textile mills, machine shops, steel plants and footwear factories have little idle machinery. A favorable feature was the renewal of buying of Bessemer pig iron on a very large scale for second-half delivery at prices representing a compromise between buyers and sellers. The situation of money is toward further ease; shipments of currency to the interior are heavy, but collections are still backward, though they are said to have notably improved in the northwest and in the eastern dry goods trade. The labor situation, despite local disturbances, is very good, and wages in many lines have been advanced. Railway congestion is less acute, and deliveries of grain, coal and other commodities are increasing. In the iron and steel trades the preëminent feature of the week was the heavy buying of Bessemer pig iron by steel making concerns, the tonnage contracted for in the Pittsburg district aggregating over 260,000 tons, 250,000 tons being for second-half delivery. Business in foundry iron is quiet, but there is some inquiry for the last half of the year. Demand for structural steel, chiefly for railway bridge building, is very heavy. Chicago interests have ordered 20,000 tons of steel rails, while China and Japan has 7000 tons. It is said that some heavy business is pending. Domestic copper —lake, electrolytic and casting—is strong for all deliveries. The prices for round tonnages ruled unchanged till the week's end at 26 a 26½ cents for lake; 25¼ a 25½ cents for electrolytic, net cash at the port of New York. Casting copper is increasingly scarce for nearby shipments at 25 a 25¼ cents sixty days. There is no visible supply of any description of prime domestic copper. *Bradstreet's* reports 194 business failures during the week ending April 11, against 137 in the week previous and 161 in the corresponding week last year.

ALUMINUM PRODUCTION.—The consumption of aluminum in the electrical arts increases steadily, and hence it is interesting to note some figures cited in the *Wall Street Journal*. There was produced in the United States during the year 1906, 14,350,000 pounds of aluminum, an increase of 4,350,000 pounds, or nearly 50 per cent over the previous year's output. It had been stated that last year a production of 20,000,000 pounds would be possible, through the enlargement to the various plants of the Pittsburg Reduction Company, but apparently these were not brought into full play during the twelve months. The Aluminum Company of America, which is the new name of the Pittsburg company, is installing a continuous rolling mill, the only one of its kind in existence, and the power capacity of the works there is also being doubled. The aluminum industry has only been in existence in this country about twenty-five years and the results of the first year's operations were eighty-three pounds, produced in 1883. It grew to 150 pounds the next year; to 3,000 pounds in 1886, and 18,000 pounds the year following. The million pound mark was reached in 1896, and last year had swelled to over 14,000,000 pounds. As far back as 1870, however, aluminum was imported into this country, the value of which was $98. Thus far this year there has been none imported, but February exports from the United States were valued at $22,208, against $11,119 in the same month last year. For the eight months ended March 1, aluminum valued at $322,022 has been exported; this compares with $229,422 in the corresponding period last year and $118,520 two years ago.

SUBWAY BIDS.—The two bids submitted for the construction of the first and most important section of the Subway loop between the East River bridges, that in Centre Street, between Pearl and Canal, were opened by the Rapid Transit Commission last week. The bidders were the Degnon Company and the Cranford Contracting Company of Brooklyn, whose bids were as follows: Degnon Company, tunnel, $2,952,000; Degnon Company, pipe galleries, $83,000; Cranford Company, tunnel, $3,775,000; Cranford Company, pipe galleries, $50,000. The difference between the two bids was a surprise. The Degnon Company built that portion of the present Subway which runs through very nearly the same territory, and is now building the Belmont tunnel under the East River. The bids were higher than the preliminary estimate of Chief Engineer Rice, who had figured that the entire loop would cost about $15,000,000, of which $6,000,000 would be used in Manhattan. For the section bid on last week Mr. Rice's estimate was $2,600,000. The work must be finished in twenty months, and a bond of $300,000 is required. The other sections will be let as soon as possible.

TELEPHONY IN INDIANA.—A. C. Lindermuth, president, and C. S. Norton, secretary of the Indiana Independent Telephone Association, are authority for the announcement that representatives of the Bell Telephone Company have made an unofficial proposition to the Independent companies in Richmond, Logansport, Fort Wayne and South Bend to turn over their local property and business in said cities in consideration of their permitting the Bell Company to connect its toll lines with the Independent Companies board for toll or long-distance business. In other words, the proposition is to abandon its local exchanges and turn over the local business to the Independents in exchange for the long-distance business of the independents. These officials say that if the deal is to cover the entire state with the possible exception of Indianapolis and Evansville, they think the proposal will be ratified by the independents.

PLANT FOR STEEL WORKS.—Following the recent purchase of ten Allis-Chalmers blowing engines for the equipment of its new steel plant at Aliquippa, Pa., the Jones & Laughlin Steel Company, of Pittsburg, has just placed orders for two direct-current generators, of the same manufacture, each of 1000-kw capacity for installation in the same plant. The two new units are of the compound-wound, engine type, to be used for supplying current for the variable power load common to the modern steel mill, where extensive use is made of electric motor drive for many purposes. These machines are wound for 250 volts and will be operated at a speed of 94 r. p. m.

THE CROCKER-WHEELER COMPANY, whose main office and works are at Ampere, N. J., has found it impossible to handle its rapidly increasing business in electric motors and generators in Birmingham, Ala., from its New Orleans and Baltimore offices, and has been obliged to establish headquarters in Birmingham. The company's rolling mill motors, built especially for this arduous service, is the C-W specialty which has made the greatest impression in Birmingham. The new office, which is in the Woodward Building, Birmingham, is in charge of Mr. B. A. Schroder, who hitherto has taken care of the New Orleans territory of the company.

WESTINGHOUSE EARNINGS.—It is stated from Pittsburg that the orders received by the Westinghouse Electric and Manufacturing Company during March represent a greater value than the business of any previous month in the history of the company, aggregating over $4,000,000. Since January 1, there has been no let-up in the record-breaking business of last year, and there are even now sufficient orders in the various departments of the East Pittsburg works to keep the shops employed to their full capacity during 1907.

THE UNITED STATES GOVERNMENT, after two years of consideration, has just awarded to the Westinghouse Companies a contract for the complete electrical equipment of the

power station now being erected in connection with the new Congressional buildings in Washington, D. C. It will be a most modern plant located about four blocks south of the Capitol in Garfield Park, and will, when finished, furnish heat, light and power for the group of buildings immediately surrounding the Capitol, namely, the Congressional Library, the new Senate and House Office buildings, and the Capitol itself. The contract calls for four 3000 hp Westinghouse-Parsons steam turbines and four 3000 hp Westinghouse generators. The machinery will all have to be delivered before the end of the present year, when the plant is expected to be in full operation. All of the apparatus is now being constructed at the East Pittsburg works. The contract also calls for 16 600-hp high-pressure Atlas water-tube boilers and four 2000-kw Westinghouse-Parsons turbines, which are to be delivered prior to the first of next year, at which time the plant, it is hoped, will be in actual operation. The order for boilers is the largest ever placed by the Government, and the plant, when completed, will be the largest and most modern of its kind thus operated in the United States. J. G. White & Co. are the consulting engineers.

PITTSFIELD SPARK COIL.—Announcement has been made by William P. Wood, treasurer and manager of the Pittsfield Spark Coil Company, of the acquirement of a half interest in the company by Zenas Crane and Senator W. M. Crane and the contemplated removal of the company's business to Dalton in the immediate future. The factory in that town owned by the Messrs. Crane and which is to be vacated by the Dalton Shoe Company has been leased for a term of five years with the privilege of buying it at the expiration of that time and in all probability by July 1 the plant will be fully installed in its new quarters. The present factory on Renne Avenue, Pittsfield, affords only 11,000 square feet of floor space, while the Dalton factory which is three stories high with a basement and is 210 feet long by 40 wide will give the company 33,600 square feet of floor space, a little over three times that of the present plant.

THE PEERLESS RUBBER MFG. COMPANY has just broken ground for a large three-story factory building at their plant at New Durham, N. J. This with other improvements, when finished, will give the Peerless Rubber Mfg. Company the distinction of having by far the largest mechanical rubber plant in the world. There will be several new calendering machines, a large number of presses for mold work, besides a new installation of washers, grinders, mixers, etc. These improvements when completed will add to the capacity of the plant about 30 per cent. For the last four years this company has been running both a night and day force, and it is hoped that the new improvements will do away with this necessity. The department in which the "Rainbow" and "Peerless" packings and the "Eclipse" gaskets are manufactured, will also be greatly enlarged and improved.

HEAVY SIGNAL ORDER.—Contracts for switches and signals for the great terminals, which it is constructing in New York, have been let to the Union Switch & Signal Company by the Pennsylvania Railroad Company. The contracts are the largest of the kind ever let by any railroad company. The exact figures are being withheld. They will cover the electric tracks from the Passaic River to a point on the Long Island Railroad east of what is known as the Sunnyside Yard. It will cover three great yards, besides the running of tracks. The work will include the complete switching, signalling and interlocking equipment for the entire distance, and it will take about a year to complete it.

STANLEY ELECTRIC FACTORY.—Osteyee Bros. have been awarded the contract to erect one of the large new factory buildings which are to be built during the spring and summer by the Stanley Electric Company at Pittsfield, Mass. The building is to be one story, about 200 by 150 feet, and will be located northeast of the entrance to the plant and at the south end of the Wright property, so called. It will be used for insulation purposes. It will connect with the blacksmithing and sawtooth buildings, and is to cost about $80,000. The Messrs. Osteyee will begin on the contract at once.

PUMPING PLANT.—The City of Rhinelander, Wis., is to have an addition to the pumping capacity of its water works in the form of an Allis-Chalmers four stage centrifugal pump, driven by a 75-hp Allis-Chalmers induction motor, recently purchased, wound for 3-phase, 60 cycles, constant speed type mounted on the same base. At full load the capacity of this unit will be 750 gallons per minute, with the motor running at a speed of 1150 r. p. m. The total head against which the pumps will operate is 231 ft.

ELECTRIC SIGNS.—The Mobile Electric Company, manufacturer of the Mobile electric signs, has sold its patents, rights, stock and business to the Federal Sign System (electric), 317 West 42d Street, New York City, Eastern representative of the Federal Electric Company, Chicago Ill. Requests for information regarding Mobile signs should be sent either to the New York office or to the Federal Electric Company, Lake and Desplaines Streets, Chicago.

LAMP FACTORY SALE.—The St. Marys Incandescent Lamp Company, of St. Marys, Pa., has recently been sold to the National Electric Lamp Company, and the factory has been closed, although it is understood that in general lamp manufacturers have lately had to do stunts to keep abreast of orders and maintain a proper lamp supply.

NEW COPPER WIRE MILL.—The Waclark Wire Company, New York, is to build an addition to its plant at Bayway, N. J., to increase its capacity for the drawing of copper wire. The new structure will be 53 x 203 ft., two stories, and will cost $35,000.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull, narrow and professional, the tendency on the part of traders being to attack prices. Public interest was lacking and the only support came from occasional covering by shorts. Actual developments bearing on the stock market were mainly unimportant. Not a little discussion was heard on the subject of reductions in prices for copper, this being mainly responsible for the weakness which developed in Amalgamated, American Smelters and others of that group. Little attention was given by the street to the new issue of Wabash notes, on terms which are but little better than those granted to the Erie in connection with its recent borrowings in that way. The heaviness of the Hill stocks, and of Reading as well, was attributed to bearish activity in them, coupled with the fact that there still seems to be opportunity for belated liquidation by tired-out holders in those securities, the same being true of St. Paul. The United States Steel stocks in the early part of the week showed a considerable degree of strength, but this was lost in the later transactions, despite the persistency with which talk about a possible increase in the dividend on the common stock for the March quarter finds circulation. Business in the electric and traction stocks was dull like the rest of the market and net declines were the rule at the close of the week. Western Union was the one exception, closing with a net gain of ¼-point. The curb market was generally heavy, ending the week with the lowest prices. The reduction in the price of copper metal here and abroad checked buying of mining issues as a whole, and the pools in them made haste to liquidate as much as they could. Following are the closing quotations of April 16:

NEW YORK.

	Apr. 9	Apr. 16		Apr. 9	Apr. 16
Allis-Chalmars Co.	12⅛	11⅜	General Electric	148½	146½
Allis-Chalmers Co. pfd.	35	32	Hudson River Tel.	..	..
American Dist. Tel.	..	..	Interborough Met. com.	26¼	25
American Locomotive.	65	62¼	Interborough Met. pfd.	60	60
Amer. Locomotive pfd.	105	106	Mackay Cos.	..	..
American Tel. & Cable.	75	75	Mackay Cos. pfd.	..	..
American Tel. & Tel.	..	..	Marconi Tel.	..	..
Brooklyn Rapid Transit	61½	60⅛	Metropolitan St. Ry.	..	..
Electric Boat	28	28	N. Y. & N. J. Tel.	..	..
Electric Boat pfd.	78	78	Western Union Tel.	82¼	82¾
Electric Vehicle	..	..	Westinghouse com.	145	146
Electric Vehicle pfd.	..	..	Westinghouse pfd.	..	..

BOSTON.

	Apr. 9	Apr. 16		Apr. 9	Apr. 16
American Tel. & Tel.	122½	123¾	Mass. Elec. Ry. pfd.	59¾	59½
Cumberland Telephone.	..	..	Mexican Telephone	..	..
Edison Elec. Illum.	208	201	New England Telep.	118½	120
General Electric	150	147½	Western Tel. & Tel.	6	7
Mass. Elec. Ry.	..	17	West. Tel. & Tel. pfd.	70	70¼

PHILADELPHIA.

	Apr. 9	Apr. 16		Apr. 9	Apr. 16
American Railways	49¼	49¾	Phila. Electric	8⅞	8⅜
Elec. Co. of America	10⅛	10	Phila. Rapid Trans.	16¾	17½
Elec. Storage Battery	55	54½	Phila. Traction	..	94⅛
Elec. Storage Bat. pfd.	..	..			

CHICAGO.

	Apr. 9	Apr. 16		Apr. 9	Apr. 16
Chicago City Ry.	*200	180	National Carbon.	72	76
Chicago Edison.	..	..	National Carbon pfd.	*110	111
Chicago Subway.	20	20	Union Traction.	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
Metropolitan Elec. com.	22	24			

*Asked.

LIGHTING IN PHILADELPHIA.—Formal application has been made at Harrisburg for charters for the Pocahontas Gas Company and the Sterling Gas, Light & Power Comapny, to manufacture gas, and operate, lease, and sub-let gas plants in the city of Philadelphia. These companies are to be subsidiaries of the Pennsylvania Gas & Power Company, of Delaware, incorporated with $100,000 capital paid in. This is a new public service corporation, for the construction and operation of gas plants, the purchase, construction and operation of electric tractions and railways, and also has the right, under its charter, to construct sewage plants and disposal stations, and to manufacture and sell fertilizers. The capital interested in the holding company represents well-known New York and Philadelphia interests, and while the organization has not been entirely completed the board of directors consists of E. A. Corbin, Jr., president of the Continental Chemical Company, Philadelphia; John J. Kirby, of New York, of Delahunty & Kirby, counsel in New York for the Bank of the Metropolis; Martin V. Bergen, Jr., who was identified with Wolf Bros. and secured the charter for that syndicate for the New Jersey & Pennsylvania Tunnel Company; Emmanuel C. Levy and Albert C. Levy, of this city, who have connections with the Guggenheims; John J. Brierly, formerly associated with the financial department of John Wanamaker, and Geo. W. Weisshaar, several years a leading politician.

DIVIDENDS.—Directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. Directors of the West Penn Railways Company have declared a quarterly dividend of ¼ per cent on the preferred stock, payable May 1. Directors of the United Electric Securities Company have declared the regular semi-annual dividend of 3½ per cent on the preferred stock, payable May 1. The regular quarterly dividend of ¾ per cent on the capital stock of the Cleveland Electric Railway is payable April 15. The directors of the Columbus (Ohio) Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the Central District Printing & Telegraph Company have declared a regular quarterly dividend of 2 per cent, payable April 30. Directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable May 15. Directors of the East St. Louis & Suburban Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. Directors of the American District Telegraph Company of New Jersey have declared the regularly quarterly dividend of 1 per cent, payable April 22.

TRACTIONS IN OHIO.—The new securities of the Cleveland, Southwestern & Columbus Traction Company will be listed on the New York Stock Exchange, and will include an issue of $10,000,000 20-year 5 per cent general mortgage bonds, $2,500,000 of 5 per cent cumulative preferred stock and $7,500,000 of common. The Cleveland, Southwestern & Columbus is a newly organized consolidation of the Cleveland & Southwestern Traction Company, the Cleveland, Ashland & Mansfield, and the Ohio Central Traction Company and is one of the most complete traction systems in the state. The system already has in operation 170 miles of track, mainly on private right of way. When the forty-four mile strip is completed between Mansfield and Seville, the system will have a direct connection between Cleveland and Columbus, and it is said that negotiations pending with the Columbus, Delaware & Marion may lead to the purchase of lease of that line by the syndicate headed by F. T. Pomeroy, president of the Cleveland, Southwestern & Columbus. The syndicate also owns the Mt. Vernon Electric Railway & Light Company, which is in line with another route from Wooster to Columbus.

ROCKY MOUNTAIN TELEPHONE.—The annual report of the Rocky Mountain Bell Telephone Company shows as follows:

	1906	1905	Increase.
Gross	$1,410,901	$1,221,774	$189,127
Expenses	1,100,018	1,003,042	96,976
Net	310,883	218,731	92,152
Dividends	300,386	140,228	160,158
Surplus	10,497	78,503	68,006

While dividend requirements had not greatly increased over the previous year, the inclusion in the charge of $159,346 carrying charges for the debt of the company, makes a large increase in this item and a correspondingly large decrease in the amount charged off to surplus. This company has a large floating indebtedness incurred for extensions and betterments. While the company has authorized an increase in the capital stock from $2,366,300 to $10,000,000 no issue of new stock has been made as yet. The probabilities are that this stock will be issued from time to time to take care of the floating debt and provide necessary working capital as needs may require.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company has issued its annual report for the year ended December 31, 1906. The income account is as follows:

	1906.	1905.	1904.
Total receipts	$771,872	$670,242	$612,933
Deductions:			
Operating expenses	126,386	114,448	101,233
Mexican Government	30,000	24,000	38,002
Cable used in repairs	32,431	11,676	29,008
Total deductions	$188,817	$150,124	$168,243
Net earnings	583,055	520,018	444,690
Dividends	263,068	191,260	191,260
Surplus	$319,987	$328,758	$253,430
Previous surplus	2,004,947	1,676,189	1,422,838
Total surplus	$2,324,934	$2,004,947	$1,676,268
Construction account expenses	521,397	.....	.....
Net surplus	$1,803,537	$2,004,947	$1,676,268

The net earnings were equal to about 19.4 per cent earned on the $3,000,000 capital stock.

CHICAGO EDISON BONDS.—A syndicate composed of N. W. Halsey & Co., A. B. Leach & Co., the Illinois Trust & Savings Bank, and the National City Bank are offering $5,000,000 5 per cent three year gold debentures of the Chicago Edison Company. The retirement of the debentures is optional on any interest day at 101. The debentures are a direct obligation of the Chicago Edison Company, and are guaranteed by the Commonwealth Company, which has a forty year franchise. Under the trust agreements executed by both the Chicago Edison Company and the Commonwealth Electric Company no obligations secured by mortgage or lien of any nature can be put out while these debentures are outstanding. The net earnings for the last fiscal year of both companies were equivalent to four and one-half times interest charges on all indebtedness of both companies, after deducting interest on all first mortgage bonds.

MO. AND KAN. TELEPHONE.—The Missouri and Kansas Telephone Company, Bell system, earned gross $2,035,421 last year, and net $390,109. The net surplus was only $9,838, as compared with $293,727 in 1905. The company increased the number of its stations, including sub-licenses, from 67,526 to 92,929, a gain of 25,403, or 37.6 per cent. The mileage of exchange wire increased from 123,747 to 186,054, a gain of 62,307 miles or 50.4 per cent. The increase of nearly $300,000 in interest charges was due to the expenditure of about $5,000,000 advanced by the American Telephone and Telegraph Company. Accounts payable at the end of the year were $11,584,696, against $6,361,194. The company has besides the 92,929 stations operating directly above, about 50,000 under other contracts making a total of about 150,000.

C. & S. A. TELEGRAPHS.—The annual report of the Central and South American Telegraph Company, for 1906 shows that while gross earnings increased 12 per cent, net earnings show a gain of 16.6 per cent over those of the previous year, apparently through economy of operation. The ratio of operating expenses to gross was almost identically the same as last year, namely, 32.6 per cent.

The principal items are as follows:

	1906.	1905.	Increase.	Per ct
Gross	$1,475,507	$1,316,249	$159,258	12.0
Expenses	481,364	430,950	50,414	11.6
Net	994,143	852,299	141,844	16.6
Surplus	475,573	378,389	97,184	25.6
P. & L. surplus	1,394,877	1,016,487	378,390	37.1

The amount of surplus for the year increased 25.6 per cent over that of the previous year.

THE LANCASTER, PA., DEAL.—Stockholders of the Lancaster County Railway & Light Company have received the first payment of 25 per cent, or $500,000, upon their holdings, which have been transferred to Bertron, Stoors & Griscom, on behalf of the McCall's Ferry power interests. Other payments of 25 per cent will be paid on June 1, Sept. 1, and Dec. 1 next, thus making the purchase price $100 per share on $2,000,000 of capital stock, the par value of which is $50 per share, or $1,000,000.

WEST SHORE TRACTION.—The West Shore Traction Company has received the consent of the State Railroad Commission to increase its capital from $250,000 to $500,000, and to issue a first mortgage of $900,000. The company will build an electric road in Rockland County from Carteret Road on the New Jersey side, to Tompkins Cove.

GENERAL NEWS

Construction News.

BRIDGEPORT, ALA.—The City Council has granted T. W. Pratt, of Huntsville, a franchise to construct and operate an electric railway; also an electric light and power plant.

GOODWATER, ALA.—The citizens voted April 8 to issue $5,000 bonds to complete the electric light plant.

JASPER, ALA.—The City Council has decided to install a municipal electric lighting plant. It is understood that the plant will be built in a short time and will cost about $10,000.

NORTH BIRMINGHAM, ALA.—The citizens have voted to issue $25,000 for an electric light plant.

TALLADEGA, ALA.—The electric light plant which has recently changed hands will be shut down for 20 days for permanent repairs. The new owners propose to renovate and rebuild the entire system, and to generate 1000 horse-power. Permission has been granted the company by the City Council to close down for a period not longer than 30 days.

TUCSON, ARIZ.—The Tucson Gas, Electric Light & Power Company will increase its capital stock to $500,000 to provide for future construction and equipment. William S. Iliff and Charles W. Durbin are among the directors.

ARKADELPHIA, ARK.—Frieby & Thrasher, of Malvern, have purchased the Arkadelphia telephone plant from H. J. Runyan, of Amity. They also own the Malvern system.

CORDELL, ARK.—The citizens have voted to appropriate $20,000 to establish an electric lighting plant and extend the water works system.

PINE BLUFF, ARK.—Extensive improvements are contemplated to the plant of the Pine Bluff Water & Light Company. Frank C. Bridges is president.

ALTURAS, CAL.—The Alturas Electric Light & Power Company, whose plant is located seven miles outside the town of Alturas, Cal., has recently undertaken substantial improvements and additions to its present equipment. A contract placed with the Allis-Chalmers Company includes a 300-kw, 6600-volts, three-phase, 60 cycle water-wheel type generator and a 9-kw exciter, also water-wheel driven, operating at a speed of 600 r. p. m. The Alturas plant, although built for electric lighting service, has heretofore been steam-driven and made no use of the water power; the installation of water wheels being an addition.

BERKELEY, CAL.—The Oakland Traction Company is contemplating the building of an electric railway to the top of Grizzly Peak.

BERKELEY, CAL.—It is reported that the Great Western Power Company, through Henry Brown, will ask the trustees for a franchise in this city as well as in Oakland for lighting and power.

EUREKA, CAL.—H. L. Jackman, manager North Mountain Power Company, writes that the proposed work contemplated by this company will cost about $500,000. Nothing definite has yet been done.

LOS ANGELES, CAL.—Los Angeles aqueduct officials have received notification from Washington stating that the forestry department has approved the application for permission to build a power plant on Division Creek. This creek is in the Owens River Valley and the power plant is to be used in connection with the water project.

MODESTO, CAL.—The Board of Supervisors of Stanislaus County has granted a franchise to W. A. Irwin to operate a street railway on certain streets in Turlock, and also on certain portions of the county road from Turlock to the Merced County line. The amount paid for the franchise was $104.

PASADENA, CAL.—The Edison Electric Company has recently served a notice on City Attorney J. Perry Wood in a new action to restrain the city from expending the money derived from the sale of the electric light bonds for construction of the electric light plant. They will also move that the court issue a restraining order for expending the money in the bond fund for construction of the plant, which, if granted, will stop at once the construction work now in progress.

PLACERVILLE, CAL.—The system of the American River Electric Company is to be improved. Paul Robinson is local superintendent.

REDDING, CAL.—The Northern California Power Company has commenced work on the Macomber Flat reservoir. The new pipe line of the company at Volta is nearly completed. The company has finished the new power house and machinery is now being placed in the station. The equipment will consist of five generating units. It is expected to have the plant in operation this summer.

REDDING, CAL.—A 10-year contract has been closed between the Trinity Copper Company and the Northern California Power Company for electric power to develop the Shasta King mine. The Trinity Copper Company has provided a 200-hp motor at the mine for immediate use. The Northern California Power Company is installing a 2000-hp plant for the use of the Mammoth mine; a 1200-hp plant for the Balaklala and a 1500-hp plant at Heroult for an iron smelter. An electric plant will be supplied to the Crown Deep mine.

SACRAMENTO, CAL.—It is stated that negotiations have been concluded for the absorption of the Capital Telephone & Telegraph Company, of this city, by the Pacific States Telephone & Telegraph Company. The Pacific States will continue to operate the Capital plant until it completes its three-story building, when the two systems will be merged.

SAN DIEGO, CAL.—A franchise has been granted to E. Bartlett by the City Council to construct and operate a street car line.

SAN DIEGO, CAL.—As a result of a conference between J. D. Spreckels and J. D. Collier, president of the Point Loma Electric Railway Company, the San Diego Electric Railway Company will build and operate the line for which the Point Loma Company has secured a franchise.

SAN FRANCISCO, CAL.—Preliminary steps have been taken for the organization of the Oriental Electric Light Company. A site has been secured and the cost of the plant is estimated at $14,000. The plant is to be built by the Chinese residents in the city.

SAN PABLO, CAL.—W. S. Rheem has been granted a franchise by the Board of Supervisors of Contra Costa County to construct and operate a street railway.

SANTA CRUZ, CAL.—Application has been made to the City Council by the Union Traction Company for a new Soquel line as far as the city limits.

STOCKTON, CAL.—The Central California Traction Company has applied to the City Council for a 40-year franchise to operate an electric railway on certain streets in this city.

COLORADO SPRINGS, COLO.—K. M. MacMillan, city clerk, writes that the citizens on April 2 voted to issue $150,000 bonds for constructing a municipal electric light plant.

BRIDGEPORT, CONN.—The Legislative Committee on Railroads has made a favorable report on the resolution incorporating the Bridgeport & Danbury Electric Railway Company, with capital stock of $2,000,000. It will construct an interurban electric railway from Bridgeport to Danbury. The company is authorized to transmit and sell electricity for light, heat and power purposes in the towns in which it operates, although it is forbidden to exercise this authority in the territory occupied by the United Illuminating Company, of Bridgeport, and the Danbury Gas & Electric Light Company.

COLLINSVILLE, CONN.—A special town meeting will be held within two weeks to vote on the proposition of having the town lighted by electricity. The Unionville Light & Power Company has submitted a proposition to the Selectmen for lighting the town.

MERIDEN, CONN.—The Meriden Electric Light Company has made a reduction of 10 per cent in the price of electricity for lighting purposes and a discount of 5 per cent for power, to take effect April 1. The price for electricity for lighting purpose is 12½ cents per kw-hour less 10 per cent, making the price 11¼ cents. The 5 per cent reduction on electricity for power will apply to the sliding scale which runs from 10 cents to 4 cents per kw-hour.

WASHINGTON, D. C.—Bids will be received at the Department of Agriculture until May 3, for furnishing to the Forest Service 3000 miles of No. 12 galvanized iron wire, 35,000 standard oak brackets and 35,000 standard insulators. One-third of this material to be delivered at Denver, Col., and the other two-thirds at Salt Lake City, Utah. Blank forms of proposals, specifications and all necessary information can be obtained from Forester, Forest Service, Washington, D. C., James Wilson, Secretary of Agriculture.

ARCADIA, FLA.—A company has been organized, with a capital stock of $15,000, to build a street railway in Arcadia. W. B. Cley, of this city, has been granted a franchise.

ATLANTA, GA.—A franchise has been granted to the Georgia Railway & Electric Company to double track its lines on several streets in the city.

MACON, GA.—The Central Georgia Railway Company will expend $1,000,000 improving and enlarging its railway shops. The machinery will be operated by electricity.

SAVANNAH, GA.—The Savannah Electric Company has applied to the City Council for permission to make two extensions.

HONOLULU, HAWAII.—Sealed bids will be received at the office of the Depot Quartermaster, 1086 North Point Street, San Francisco, Cal., until May 3 for the construction, plumbing, electric wiring, etc., of a pumping station, and for the construction of a 300,000-gallon reservoir at the new military post, Kahauiki, Honolulu, H. T. Plans and specifications and proposal blank may be obtained at this office. For further information address Lieutenant-Colonel J. B. Bellinger, Depot Quartermaster, U. S. A.

BOISE, IDAHO.—The Boise Traction Company is contemplating rebuilding its entire line. I. W. Anderson is president.

JERSEYVILLE, ILL.—The Alton, Jacksonville & Peoria Railway Company has filed a certificate announcing an increase in its capital

stock from $300,000 to $800,000. The company has also been granted authority to borrow money not to exceed $800,000. The company is planning to construct a line from Alton to Jacksonville in the near future.

MASON CITY, ILL.—The Mason City Telephone Company has increased its capital stock from $2,500 to $7,500.

ROCKFORD, ILL.—The stockholders of the Central Heat & Power Company have decided to increase the capital stock of the company to $200,000.

AVERY, IND.—The Avery Telephone Company has been incorporated, with a capital stock of $2,100.

BROOKVILLE, IND.—Capitalists of Cincinnati and Aurora have been awarded a contract for lighting this city for a period of 20 years at $54 per lamp per year on the moonlight schedule. It is understood that a new plant will be established.

CONNERSVILLE, IND.—Local capitalists are promoting a street railway system for this city with a branch line to Milton. A representative of the General Electric Company has been in Connersville gathering data upon which to furnish estimates for building and equipping the system.

DANVILLE, IND.—The Danville Heat, Light & Power Company recently incorporated, has decided to receive bids for the construction and equipment of a plant to supply heat, light and power. J. F. Lynch is President.

FORT WAYNE, IND.—Bids will probably be received by the Board of Public Works about June 12 for the construction of municipal electric light and power plant for lighting streets and public buildings, to cost about $160,000. The power plant will have a capacity for operating two 500-kw turbine units or three 250-kw engine type alternating-current generators. About 420 arc lamps will be installed. William J. Hosey is Mayor.

HOPE, IND.—George S. B. Cook has petitioned for a franchise to establish a telephone and electric system.

LEBANON, IND.—It is reported that in addition to reconstructing and equipping the water works plant, the city will expend $35,000 in improving the electric light plant.

LEBANON, IND.—At a recent meeting of the directors of the Lebanon Telephone Company it was voted to change the system from a magneto to a full common battery system; also to build a new exchange building on land recently purchased by the company.

MAJENICA, IND.—The capital stock of the Majenica Telephone Company has been increased from $25,000 to $60,000.

MISHAWAKA, IND.—The Chicago, South Bend & Northern Railway Company has applied to the City Council for a franchise to construct and operate an electric railway in this city.

NEW ALBANY, IND.—The United Gas & Electric Company, of this city, has filed notice with the Secretary of State of its intention to enlarge its plant and territory in order to furnish water, light, heat and power not only for New Albany and vicinity, but also for Jeffersonville and vicinity. Charles D. Kelso, Martin J. Insul and R. W. Waite are the directors.

NORTH MANCHESTER, IND.—The plant of the North Manchester Electric Light Company has been destroyed by fire.

AMES, IA.—At a special election held April 9, the citizens voted to grant a franchise to the Fort Dodge, Des Moines & Southern Interurban Railway Company to construct an electric railway through this place.

CANTRIL, IA.—E. E. McKee has secured a franchise for an electric light plant.

DES MOINES, IA.—The Mutual Telephone Company is contemplating the installation of a new exchange on the East Side and other improvements which will cost about $75,000.

MORAVIA, IA.—D. E. Bishop, city recorder, writes that W. C. Blair, of McCook, Neb., has secured franchise for electric light plant.

HAGERSTOWN, MD.—The annual report of the operation of Hagerstown's municipal electric lighting system shows the plant to be in a prosperous condition. Besides lighting the city with 141 arc lamps, at a cost of only $11.37 a lamp for the year, as against $75 per lamp paid when the Hagerstown Railway Company lighted the town, the plant made a profit last year of $22,000, derived from electricity furnished citizens for private use. Eight thousand dollars was received from taxes levied for lighting purposes. The expenditures amounted to nearly $30,000. Six thousand dollars was expended in betterments on the plant. The city paid $2,300 interest on bonds issued to build the plant, which is now valued at $67,000.

BARRE, MASS.—The citizens have voted to appropriate $1,050 for lighting the highway between South Barre and Barre Plains. The Selectmen were authorized to contract with the Francis Willey Company to carry out the work. The company agrees to furnish 20 incandescent lamps and six arc lamps for $650 and to furnish electricity for operating the same for $400 per annum.

DEDHAM, MASS.—A committee consisting of J. L. Wakeman, H. D. Humphrey, P. J. Hannon, A. E. Buffum and H. R. Hayes has been appointed to consider a new lighting contract and the installing of an independent lighting plant by the town.

NORTHAMPTON, MASS.—Since placing orders for a 500-kw Allis-Chalmers 60-cycle, three-phase, 2300-volt steam turbine unit, the Light, Heat & Power Corporation of Northampton, Mass., has ordered a 375-kw Allis-Chalmers engine type alternating-current generator and a 17½-kw exciter of the same make for the Northampton Electric Lighting Company. The new units will be used on its lighting and power load.

PITTSFIELD, MASS.—The Board of Railroad Commissioners has approved an issue of bonds by the Pittsfield Street Railway Company to the amount of $100,000.

STURBRIDGE, MASS.—The citizens have voted to have the streets of the town lighted by electricity.

WARREN, MASS.—At a town meeting held April 7 the citizens voted to instruct the Selectmen to obtain bids from the Worcester County Gas Company and the Central Massachusetts Electric Company for lighting the streets, and authorizing them to contract with the lowest bidder. The appropriation for street lighting was cut down to $2,000.

ALLEGAN, MICH.—William N. Hull has applied for a franchise in this town, proposing to build an electric railway from Allegan to South Haven, with a spur to Otsego.

BELLAIRE, MICH.—The citizens have voted to issue $15,800 water works bonds and $6,200 to raise and strengthen the dam and enlarge the power house.

CHELSEA, MICH.—The Detroit, Jackson & Chicago Electric Railway is planning to erect a new power house in this place.

ESCANABA, MICH.—T. J. Burke, city clerk, writes that new bids will be received for improvements to the electric light plant, to cost about $16,000. John Roemer is superintendent.

BOVEY, MINN.—The village recorder writers that the citizens have voted to issue $7,000 bonds for the construction of an electric light plant.

MINNEAPOLIS, MINN.—B. F. Nelson, of the Nelson-Tuthill Lumber Company, of Minneapolis, is interested in the establishment of a power plant on the Mississippi River, at some point between Clearwater and the mouth of Minnehaha Creek.

WESTBROOK, MINN.—K. Krueger is interested in the construction of an electric light plant.

WINONA, MINN.—Winona City Council has granted a 50-year light and power franchise to the La Crosse & Winona Traction Company, the provisions of which compel the company to build at once an electric railroad from Winona by way of La Crosse to Galesville, Wis.

HATTIESBURG, MISS.—The Mammouth Mineral Springs Company is contemplating the construction of an electric railway into this city.

PASS CHRISTIAN, MISS.—A company composed of local and New Orleans people is being organized here for the purpose of establishing an electric light and power system.

PENDER, NEB.—M. M. Neumann is interested in the construction of an electric light plant.

STANTON, NEB.—At an election held recently the citizens voted to purchase the local electric lighting plant, which is owned by Frank L. Sanders & Company. The franchise expires next October, and a proposition has been made by the company to turn the plant over to the city at that time.

JOHNNIE, NEV.—The Brock-Miller interests owning the Tonopah & Goldfield Railroad, expect to continue their line south through Johnnie to Tecopah, Cal., some 60 miles south of Johnnie. In this connection there will be launched, according to the latest reports, a big agricultural, mining and power enterprise. By utilizing the water obtainable it is expected that electricity will be generated sufficient for mining and lighting and for the operation of the railroad.

RENO, NEV.—Charles Burke and D. C. Wheeler have applied to the City Council for a franchise for an electric road.

RENO, NEV.—The Truckee River General Electric Company is to furnish power to the mines of the Yerington district.

CLAREMONT, N. H.—The Claremont Power Company, which was recently incorporated, has been organized with the following directors: W. L. Mauran and Thomas E. Steere, of Providence, R. I.; Hira R. Beckwith, L. N. Wheelock, Frank H. Foster, of this place. It was decided to capitalize the company at $7,000,000. The directors elected officers as follows: W. L. Mauran, president; Hira R. Beckwith, vice-president; L. N. Wheelock, treasurer and manager. This company is to be a holding company in the development of the water power at Cavendish Gorge, Vt., with a working merger with the Black River (Vt.) Power Company.

HIGHTSTOWN, N. J.—J. W. Parker, superintendent of the Hightstown Electric Light & Power Company, has submitted a proposition to the Town Council for pumping the city water in connection with running the electric light plant, also for furnishing an all-night service of street lighting.

NEWARK, N. J.—Jas. M. Seymour, Jr., of Newark, has completed plans for the municipal electric light plant for the City Hall, to cost about $30,000. The specifications call for three engines and three generators of 100-kw capacity each, and provide for bids on part or all of the work. Michael J. McGowan, Jr., is chairman of the Lighting Committee.

ROCKAWAY, N. J.—At the adjourned meeting of the Mayor and Council April 5, John H. Miller, president of the Rockaway Electric Light & Improvement Company, presented a written notice withdrawing his company's offer to sell its plant here to the borough. The Council passed a resolution accepting the proposition. The company has applied to the Borough Council for a new franchise.

CHARLOTTE, N. Y.—A report recently sent to the taxpayers of the village of Charlotte in regard to the municipal electric light and water plants shows that the entire equipment of the plants is in need of repairs, and that practically all new machinery will have to be installed. The cost of putting the plants in good condition is estimated at $18,000. Frank Pye is president of the village.

EAST CREEK, N. Y.—Plans have been drawn for the erection of a large power plant near Ingham's Mills on East Canada Creek by the East Creek Electric Light & Power Company. The company contemplates developing East Canada Creek to generate electricity to operate the entire system of the Fonda, Johnstown & Gloversville Railroad, as well as furnishing electric energy for Amsterdam, Johnstown and Gloversville.

ELMIRA, N. Y.—The Elmira, Corning & Waverly Railway Company has been authorized by the State Railroad Commission to issue a first mortgage for $5,000,000 on condition that but $1,500,000 shall be issued now, and that the consent of the Commission shall be obtained before issuing any of the remaining $3,500,000.

ELMIRA, N. Y.—The Gould Storage Battery Company, of New York City, recently purchased an Allis-Chalmers 600-ampere, 140-volt induction motor-driven generator set for the Elmira Water, Light & Railroad Company, of Elmira, N. Y. The set will be composed of an interpole shunt wound generator, designed for a normal rating of 600 amperes at 140 volts, mounted on a combination base with a 60-cycle, three-phase standard induction motor of same make.

LYNBROOK, L. I., N. Y.—The citizens of Lynbrook are considering the question of establishing a lighting district to be lighted by electricity. The Queens Borough Gas & Electric Company has submitted a proposition and estimate for installing a system of 150 lamps and the cost, furnishing electricity and service for the same.

NEW YORK, N. Y.—Bids will be received by the Commissioner of Bridges, at the office of the Department of Bridges, 13 Park Row, New York City, until April 25 for installing the ventilating system and the electrical equipment for the Manhattan subway station of the Williamsburg Bridge. Blank forms, plans and specifications may be obtained at the office of the Department of Bridges. J. W. Stevenson is commissioner.

NIAGARA FALLS, N. Y.—The Common Council will receive until May 13 bids for the services of an electrical expert to determine the cost of installing a municipal lighting plant in this city and the cost of light and power to the citizens from said plant. A. C. Douglass is mayor.

NYACK, N. Y.—The West Shore Traction Company has been authorized by the State Railroad Commission to increase its capital stock from $250,000 to $500,000, and to issue a first mortgage of $900,000.

ONEIDA, N. Y.—The State Commission of Gas and Electricity at Albany has received application from the Oriskany Hydro-Electric Company, of Oneida, for permission to do business and consent to issue $400,000 stock and $335,000 bonds. The company proposes to supply electricity in 32 cities and towns, mostly in Oneida County, including Utica, Rome, Oneida and Waterville.

OSWEGO, N. Y.—The People's Gas & Electric Company is contemplating the erection of a large power plant.

CHARLOTTE, N. C.—The Southern Power Company is extending its transmission lines to Piedmont, S. C., and is making plans for the construction of a distributing plant and equipment to be located at Spartanburg, S. C., to cost $100,000.

GRAND FORKS, N. D.—If the contract with the Grand Forks Gas & Electric Company for furnishing the city with electricity is accepted by the City Council, it will be necessary for the city to provide a distributing station, the location of which is now under consideration by the light committee.

MINOT, N. D.—The City Council has adopted a resolution notifying L. M. Davis that the franchise of the Minot Light & Telephone Company will be revoked at the end of six months.

WAHPETON, N. D.—L. B. Hanna, of Fargo, is contemplating the construction of an electric railway to Breckenridge.

DAYTON, OHIO.—The stockholders of the Home Telephone Company have increased the capital stock of the company from $1,200,000 to $2,000,000.

ELYRIA, OHIO.—Bids will be received for the erection of a complete lighting plant in this city.

HAMILTON, OHIO.—The Board of Public Service has decided to combine the new water works and municipal electric light plant under one roof. Both systems will be operated by one power plant. The city is spending about $300,000 in enlarging and improving both plants.

LAKEWOOD, OHIO.—The Cleveland Electric Illuminating Company has been awarded the contract to light the village streets. The contracts call for 150 or more arc lamps at $52.33 per lamp per year. The company recently purchased the municipal electric lighting plant.

URBANA, OHIO.—The Urbana Telephone Company is arranging to establish a new central station in this place.

WAUSEON, OHIO.—The Northwestern Ohio Telephone Company has increased its capital stock from $40,000 to $65,000.

YOUNGSTOWN, OHIO.—The Collins Construction Company, of Chicago, Ill., has been awarded the contract for the construction and equipment of an electric road connecting the cities of Canton, Youngstown with Akron, a distance of 65 miles.

YOUNGSTOWN, OHIO.—The Consolidated Railway & Light Company is contemplating extensive improvements and additions to its power plant on North Avenue, which, when completed, with the power plant at Sharon, Pa., will furnish electricity for operating all its electric railways and also for lighting furnished by the company. The power stations on West Federal Street, Niles, and Edenburg, Pa., will be dismantled when the North Avenue plant is completed. The company is also planning to build a new fuel conveyor for its plant.

CORDELL, OKLA.—The citizens voted to issue $20,000 bonds to establish a lighting plant and extend the water works. A. W. Lee, city clerk, writes that the proposed electric light plant and water works extension will cost about $12,000. An engineer has not yet been selected.

EUGENE, ORE.—The citizens have voted to issue bonds for water works and an electric light plant.

JEFFERSON, ORE.—The citizens have voted to issue bonds for an electric lighting system.

NORTH BEND, ORE.—The construction of electric railway, a larger electric light and power plant and a gas plant at Coos Bay is under consideration by Hewitt, Simpson & Bell, work on which will commence as soon as spring opens.

OREGON CITY, ORE.—The Portland Light & Power Company will expend $100,000 in this city.

RANIER, ORE.—The Ranier Electric Power Company has made arrangements to secure electricity for operating its plant from the Kalama Electric Company, at Kalama. The company is now erecting its wires and expects to finish the work in June, when a 24-hour service will be established.

JOHNSTOWN, PA.—The finance committee of the City Council has increased the appropriation for street lighting from $16,200 to $18,000. The increase provides for 50 additional arc lamps.

KANE, PA.—The Council has granted H. J. James, A. P. Huey and others, representing the Kane Electric Light & Power Company, a franchise for term of 25 years.

LANGHORNE, PA.—A company is being organized under the name of the Langhorne Transportation Company for the purpose of operating a line of electric passenger automobiles between Langhorne and Morrisville, beginning not later than May 1. William B. Parry, of Langhorne, is at the head of the company.

MORRISVILLE, PA.—The Borough Council has granted a franchise to the New Jersey & Pennsylvania Traction Company for its extension to Fallsington.

NAZARETH, PA.—Borough Council has passed an ordinance granting a franchise to the Nazareth-Bath Electric Railway Company.

PENNSBURG, PA.—The Town Council has decided to appoint a commission to operate the electric light plant and to take further action in regard to the building of the system.

PROVIDENCE, R. I.—Extensive improvements are contemplated by the Rhode Island Company which will involve an expenditure of about $1,310,000, of which $425,000 is for the enlargement of the Manchester Street power plant.

ANDERSONVILLE, S. C.—J. R. Earle, of Walhalla, writes that it is proposed to develop the power at Andersonville Shoals. The cost of the plant complete will be $500,000. Bids are now being received.

BENNETTSVILLE, S. C.—A survey has been made for an electric railway from Bennettsville to Blenheim, a distance of about eight and one-half miles. J. J. Matheson is back of the enterprise.

COLUMBIA, S. C.—E. W. Robertson and William Elliott, Jr., who are at the head of the Columbia Electric Street Railway, Light & Power Company, of this city, which operates the local street railways and the gas, electric light and power services, are now also in control of the Anderson Traction Company, which owns the electric railway system in Anderson. Mr. Robertson has been elected president and treasurer, and Mr. Elliott vice-president and general manager of the Anderson Company. J. A. Brock, of Anderson, who organized the Anderson company and has been its president, voluntarily retires in order to devote more time to his other interests.

MITCHELL, S. D.—John Absher, of Wagner, has petitioned for a franchise for an electric light plant.

HURON, S. D.—The South Dakota Gas-Electric Railway Company has under consideration the construction of a street car line in this place. J. A. Cleaver, mayor, is interested.

PLATTE, S. D.—This town is considering the granting of a franchise for an electric light plant.

CHATTANOOGA, TENN.—Beginning with bills dated May 10 the Chattanooga Electric Company will reduce the price of electricity from 17½ and 9 cents per kw-hour to 15 and 7 cents respectively. In addition to this reduction, a cash discount of 20 per cent will be given if bills are paid within 15 days, which makes a reduction of about 16 per cent. The company will expend about $140,000 in improvements to its system. Bryon T. Burt is manager.

GREENEVILLE, TENN.—This city is considering the purchase of the water and electric light plant now owned by a stock company.

MEMPHIS, TENN.—The Memphis Street Railway Company is contemplating further additions to its power plant.

McGREGOR, TEX.—W. F. Barclay has been appointed receiver for McGregor Artificial Water Company, which operates the electric lighting and water systems in this place.

BOUNTIFUL, UTAH.—The question of constructing a municipal electric light plant is being considered here.

CLIFTON FORGE, VA.—J. A. Gleason, chairman Water and Light Committee, writes that the franchise for lighting the streets has been awarded to the Clifton Forge Light & Water Company, which already has a plant in operation here. The company bid $800 for the franchise and agrees to furnish electric lamps to the city for 40 per cent less than it is now paying, and offers a reduction of 15 per cent to private consumers. The franchise is for a term of 15 years.

TEKOA, WASH.—Application has been made to the City Council by the Tekoa & St. Maries River Railway Company for a franchise to construct and operate its line on the streets of the town. Dr. W. A. Moshier represents the company.

ELKINS, W. VA.—The promoters of the Elkins Electric Railway have applied for a franchise to operate an electric railway in this place. J. F. McSpattan and W. K. Taylors, of Pittsburg, are interested in the project.

MORGANTOWN, W. VA.—The Elkins Coal & Coke Company, of Morgantown, W. Va., whose properties are located within short distances of this place, have recently purchased Allis-Chalmers electrical equipment for use at Bretz, W. Va. The new machinery comprises a 300-kw Allis-Chalmers alternator, a 200-kw rotary converter, three 75-kw transformers, a 27½-kw exciter, standard induction motors, of 20 to 150 hp capacity, with switchboard equipment. Davis Elkins is president of the company.

REEDSVILLE, WIS.—The citizens have voted to issue $3,500 bonds for constructing an electric light plant in connection with the water works. W. G. Kirchoffer, of Madison, is engineer.

SPARTA, WIS.—The Sparta-Melrose Electric Light & Power Company has petitioned for a franchise in this place.

VERNON, B. C.—John Galt, civil engineer, of Toronto, has prepared an estimate for the City Council on the proposition of developing the electrical power at Shuswap Falls and finds the work will cost $170,000. This includes the cost of a 26-mile transmission line from the falls to this town.

MORDAN, MAN.—Ratepayers will vote on a proposition to raise $20,000 for the construction of an electric lighting plant.

WINNIPEG, MAN.—The Winnipeg City Council has decided to ask the Provincial Government to construct a system in Winnipeg during the coming summer. Some 10,000 telephones will be required, and it is understood the Government will put the subscription price at the lowest possible figure to make the system self-supporting. Francis Dagger, provincial telephone expert, is now preparing figures for this system and it is expected active construction will be commenced this spring.

INGERSOLL, ONT.—Prices at which Niagara power can be sold to consumers in this place per horse-power for a 10-hour day at full load have been submitted to the Fire, Water and Light Committee by Engineer Richards, of the Hydro-Electric Power Commission, which are as follows: Five horse-power, $34.50 per annum; 10 horse-power, $33 per annum; 25 horse-power, 30 per annum; 50 horse-power, $27 per annum; 100 horse-power, $25 per annum; 200 horse-power, 24 per annum.

HAILEYBURY, ONT.—Beach Bros. Company, of Haileybury, writes that it is proposed to develop the water power there under the name of the Cobalt Power Co., Ltd., of Haileybury. About 5000 horse-power will be developed, at a cost of about $200,000. Specifications for the machinery required will be ready in about three weeks.

Company Elections.

CARLINVILLE, ILL.—At the annual meeting of the Carlinville Telephone Company held April 6, the following officers were elected: G. R. Waggoner, president; George James, vice-president; George H. Clark, secretary; Abner Stratton, treasurer and Edward A. Forwood, manager.

BALTIMORE, MD.—At the annual meeting of the directors of the United Railways & Electric Company held April 10 the following officers were elected for the ensuing year: William A. House, president; Frank A. Furst, vice-president; William Early, secretary; J. H. Windsor, acting treasurer and Thomas A. Cross, general manager.

DETROIT, MICH.—At the annual meeting of the Michigan State Telephone Company held April 9, the following officers were elected: W. A. Jackson, president; W. E. Waters, first vice-president; N. C. Kingsbury, second vice-president; W. I. Mizner, secretary; John T. Shaw, treasurer; W. L. Burrows, assistant treasurer and H. J. Booth, auditor.

DUNDEE, N. Y.—At the annual meeting of the Dundee & Crystal Springs Telephone Company the following officers were elected: Frank M. Van Gorden, president; Alfred Horton, vice-president; Lyman Disbrow, secretary, treasurer and general manager.

ROCHESTER, N. Y.—At a meeting of the directors of the United States Telephone Company held April 9, the following officers were elected for the ensuing year: T. W. Finucane, president; Lee Benoist and Joseph J. Heim, of Kansas City, and John M. Rauber and John C. Woodbury, of Rochester, vice-presidents; W. Roy McCanne, secretary and treasurer and Henry M. Bingham, assistant secretary.

SPRINGFIELD, OHIO.—At the annual meeting of the stockholders of the People's Light, Heat & Power Company, held recently, the present officers were re-elected as follows: John L. Zimmerman, president; L. M. Ferguson, vice-president; John K. Henry, secretary; W. W. Kiefer, treasurer; Charles S. Kay, general manager.

PHILADELPHIA, PA.—At the annual meeting of the stockholders of the Philadelphia Electric Company the following board of directors was elected: Thomas Dolan, Jeremiah Sullivan, William F. Harrity, Charles D. Ingersoll, John V. Shoemaker, J. R. McAllister, William D. T. Conover, Jr., A. V. R. Coe and Joseph B. McCall.

New Industrial Companies.

THE AMERICAN ELECTRICAL PROCESS COMPANY, of Kittery, Me., has been incorporated, with a capital stock of $500,000, by Horace Mitchell, M. G. Mitchell, Benjamin F. Bunker, Oliver P. Philbrick, Kittery, Me.; S. J. Morrison, Portsmouth, N. H.

THE GEORGE E. BLACK ELECTRIC COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $25,000, by George E. Black, John Cuthbert and Robert J. Frank. The company is capitalized at $25,000 and proposes to manufacture electrical devices and supplies.

THE C & C ELECTRIC COMPANY, of Newark, N. J., has recently been incorporated in Chicago, Ill., with a capital stock of $25,000. The capital stock of the Newark company is $1,400,000.

THE CUTHBERT ELECTRICAL MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $26,000, for the purpose of manufacturing electrical and hardware specialties. The incorporators are: John Cuthbert, George E. Black and Robert J. Frank.

THE EDSON ELECTRIC AMUSEMENT COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $1,000, to operate amusement enterprises. The incorporators are: Fred A. Fischerupp and M. A. Edson.

THE EMPIRE OIL-GAS ENGINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000. The directors are: C. F. Baker, A. H. Stephens, New York, and R. Schroeder, of Hoboken, N. J.

THE GREEN RIVER MANUFACTURING COMPANY has been organized, with a capital stock of $250,000, to develop water power in Henderson County, N. C., and erect a manufacturing plant. S. B. Tanner and J. A. Durham, of Charlotte, N. C., are interested in the project.

THE NATIONAL CAMERA PHONE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $150,000. The directors are: J. A. Whitman, A. F. Wainwright and Francis Fitch, of New York.

THE SCHAEFFEL ELECTRIC CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State, with a capital stock of $50,000. The directors are: E. A. Schaeffel, George Omerod and Julian Ostis, of New York, N. Y.

New Incorporations.

TALLADEGA, ALA.—The Alabama Power & Electric Company has been incorporated, with a capital of $75,000. The company embraces the Talladega Electric & Power Company and the Little River Power Company, its purpose being to furnish water power for a large part of northeastern Alabama. J. H. Hanson, of New York, N. Y., is president; R. H. Mitchell, Alabama City, Ala., second vice-president; H. W. Sexton, of Anniston, and J. K. Dixon, Talladega, are also stockholders.

LAKEPORT, CAL.—Articles of incorporation have been filed for the Sonoma County Railway Company, with an authorized capital stock of $1,000,000. The following are the officers and directors: M. C. Dickinson, of Ukiah, president; J. E. Fulton, vice-president; W. S. Fry, secretary; J. R. Garner, treasurer; J. W. Preston, J. A. Sparks, D. F. MacIntire, W. P. Meredith and W. N. Johnson. It is the purpose of the company to construct an electric railway from Cloverdale to Lakeport with a branch to Kelseyville.

SANTA CRUZ, CAL.—The Davenport Light & Power Company has been incorporated, with a capital stock of $10,000, by E. E. Burgen, of San Francisco; E. O. E. Klipphan, of Sacramento, and J. S. Thompson, of Mill Valley. The place of business is to be San Francisco.

BRIDGEPORT, CONN.—A certificate of organization has been filed by the Syracuse Light & Power Company, of Bridgeport, with the following officers: George S. Philler, of Philadelphia, Pa.; W. H. Marshall, of Philadelphia, Pa.; Lewis Lillie, Haverford, Pa.; Charles H. Werner, New York, N. Y., secretary; William T. Hincks, of Bridgeport, is named as the person whom process against the company may be served.

WASHINGTON, D. C.—The Washington Spa Spring & Gretta Electric Railway Company has been organized, and the following officers elected: B. D. Stephen, president; S. S. Yoder, vice-president; Fillmore Beall, secretary; R. N. Ryon, treasurer, and James C. Rogers, of Hyattsville, Md., general counsel.

ATLANTA, GA.—A charter has been issued to the Macon, Americus & Albany Electric Railway Company, with a capital stock of $200,000, to build a line from Macon to Albany, Ga., a distance of 199 miles.

RATHDRUM, IDAHO.—The Idaho, Washington & Northern Railroad has filed articles of incorporation, with a capital stock of $5,000,000. E. H. Belden, Spokane, Wash., is interested in the project.

WALLACE, IDAHO.—The Inland Power Company is being formed by

Stephen P. Wright, of Butte, Mont.; G. Scott Anderson, of Wallace, Jas. H. McDoney, of Chicago, Ill., and others, to construct a power plant on Big Creek, southeast of Wardner, to supply mines in that section with electric power. The probable cost of the plant is placed at $300,000.

MINERAL CITY, ILL.—The Beggars' Run Telephone Company has been incorporated, with a capital stock of $3,000, by Abraham Boyd, Thomas Herron, Emmet S. Dilley, Irwin Farber and Samuel Edwards.

VIRDEN, ILL.—The Virden & Taylorville Traction Company has been chartered, with a capital stock of $2,500, to build a line from Roodhouse to Taylorville, a distance of 75 miles. It is the intention of the company ultimately to construct a line from Quincy, Ill., to Terre Haute, Ind. The incorporators are: E. E. Barclay, Springfield; H. C. Simons, John Gelder, W. E. Anderson, E. R. Toney, and others, of Virden, Ill.

GOSHEN, IND.—The Ecklebarger Gas & Light Company has been incorporated to establish a plant to manufacture gas and electricity, generating and distribution plants and appliances. Daniel M. Bowser is president.

INDIANAPOLIS, IND.—Two new telephone companies have recently been incorporated by the Secretary of State, the St. Philips Telephone Company, capitalized at $2,000, and the Brookville-St. Peters Telephone Company.

SHELDAHL, IA.—The Sheldahl Telephone Company has been incorporated, with a capital stock of $6,000, by R. F. Graeber, Isaac Brown, George Burkey, A. F. Sargent, A. Frick and E. Russell.

LAWRENCE, KAN.—The Lawrence Electric Transportation Company has been chartered, with a capital stock of $200,000, to equip and operate electric cars in the city of Lawrence. O. W. Murphy, Dr. J. A. Hamlin and others are interested.

MISSOULA, MONT.—Articles of incorporation have been filed for the Missoula & Bitter Root Traction Company by P. J. Shannon, O. Blood, J. L. Humble, E. O. Lewis and W. W. McCracken. The company is capitalized at $40,000.

WELLSVILLE, N. Y.—The Hanover Hill Mutual Telephone Company has been incorporated, with a capital stock of $200, by Henry Hornberg and others.

BRYSON CITY, N. C.—The Bryson City Light & Power Company has been chartered. The capital stock is $50,000. R. J. Abbott and J. L. Gibson are among the stockholders.

CEDAR GROVE, N. C.—The Cedar Grove-Elfland Telephone Company has been chartered with $1,000 capital stock by Joel F. Anderson, Cedar Grove, and Charles A. McDade, Hillsboro, N. C.

OXFORD, N. C.—The Granville Telephone Company has been chartered with a capital stock of $50,000 by E. C. Clement and others.

TAYLORSVILLE, N. C.—The People's Telephone Company has been chartered with $20,000 authorized capital to build telephone lines in Iredell and Alexander counties. R. E. Tatum, O. L. Holler & Company and others are the incorporators.

BOWDEN, N. D.—The Bowden Telephone Company has been incorporated with a capital stock of $2,500. The incorporators are Almon D. Priest and others.

FARGO, N. D.—The Fargo Union Telephone Company has been incorporated with a capital stock of $5,000 by C. A. Stromberg and others.

FARGO, N. D.—The Northern Electric Company has been incorporated with a capital stock of $150,000. John Watson is president.

FESSENDEN, N. D.—The German-Oshkosh Telephone Company has been formed. A. Markwart is president.

GLEN ULLIN, N. D.—Articles of incorporation have been filed for the Tavis-Moore Telephone Company by L. A. Tavis and others. The company has a capital stock of $50,000.

GREAT BEND, N. D.—The Great Bend Telephone Company has been incorporated with a capital stock of $15,000 by A. Bohn and others.

MILNOR, N. D.—The Milnor Rural Telephone Company has been incorporated with a capital stock of $10,000 by Arnold Christensen and others.

BELLEFONTAINE, OHIO.—Articles of incorporation have been issued to the Logan County Farmers' Telephone Company, which is capitalized at $5,000. W. J. Dachenbach is one of the incorporators.

BETHESDA, OHIO.—Articles of incorporation have been filed for the Bethesda Heat, Light & Power Company by T. Riley Hoffman, T. Stuggers and others.

CLEVELAND, OHIO.—The Stacey & Burns Electric Company has been incorporated, with a capital stock of $10,000, by R. L. Stacey, L. L. Burns, G. H. Palmer and others.

CUMBERLAND, OHIO.—The Cumberland Farmers' Telephone Company has been incorporated, with a capital stock of $5,000, by J. M. Hunter and others.

NEWCOMERSTOWN, OHIO.—Articles of incorporation have been filed for the Newcomerstown Electric Light, Heat & Power Company with a capital stock of $25,000. The company is erecting a new plant on the premises of the Novelty Brick & Coal Company, with which the new concern is closely connected.

NEW REIGEL, OHIO.—The Mutual Telephone Company has been organized with Lewis Huss president.

NOVA, OHIO.—The Nova Telephone Company has been incorporated with a capital stock of $500 by J. J. Dieter and others.

PANDORA, OHIO.—The Pandora Mutual Telephone Company has been incorporated by John T. Mallahan and others.

PATASKALA, OHIO.—Articles of incorporation have been filed for the Pataskala Farmers' Telephone Company with a capital stock of $10,000 by Frank Headley and others.

PLEASANT CITY, OHIO.—The Pleasant City Farmers' Telephone Company has been incorporated with a capital stock of $2,000.

RAINSBORO, OHIO.—The Rainsboro Telephone Company has been chartered with a capital stock of $10,000 by J. B. Upp and others.

SALEM, OHIO.—Articles of incorporation have been filed for the Salem Street Railway Company with a capital stock of $10,000 by W. M. Baldwin, George Lomnitz, F. Williams, F. H. Fowler and F. P. Shelhorn.

SHINNOCK, OHIO.—The Erie County Mutual Telephone Company has been incorporated by F. J. Groves and others, the capital stock being $10,000.

SPRATT, OHIO.—The Muskingum County Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by H. J. Herron and others.

TOLEDO, OHIO.—The Toledo & Defiance Railway Company has been incorporated with a capital stock of $10,000 by Clem V. Wagner, M. I. Brown, M. O. Topuiff, H. C. A. Ehlert and C. V. Ferson, all of Toledo.

TOLEDO, OHIO.—The Toledo, Wabash & St. Louis Railroad Company has been incorporated and will build an electric railway from Toledo to St. Louis. C. D. Whitney, of this city, is president; George G. Metzger, vice-president; S. L. McAfee, secretary; J. P. McAfee, treasurer, and Riggs & Sherman are the consulting engineers. The capital stock is $6,000,000.

HERMISTON, ORE.—The Western Umatilla Mutual Electric Company has been incorporated for the purpose of supplying electricity for light and power to the territory under the Umatilla Government project. The capital stock of the company is $50,000, and the incorporators are: M. B. Guinn, James A. Fee, R. Alexander and E. P. Todd. James Fee is president.

OREGON CITY, ORE.—Articles of incorporation have been filed for the Oregon City, Beaver Creek & Molalla Railway Company by G. B. Dimmick, Thomas F. Ryan and J. W. Sherwood, of Portland. The capital stock of the company is $100,000.

HARRISBURG, PA.—Charters have been granted at the State Department to the following electric railway corporations: Ellwood City and Hazel Dell, capital, $25,000; directors, C. J. D. Strobecker, of Zelinople, president; Wm. Finch, M. B. Dewey, Jordan Johnston and N. B. Duncan. Greensburg & Western, capital, $60,000. The company will build its line over private right of way for much of the distance. The directors are: William S. Kuhn, president; Jas. S. Kuhn, Jesse H. Purdy, Jacob B. Van Wagener and Robert P. Watt, all of Pittsburg.

INDIANA, PA.—A charter has been granted to the Indiana, Punxsutawney & Sagamore Street Railway Company, which is to construct an electric railway from Indiana County to Punxsutawney. The capital of the company is $210,000. The road will be 35 miles in length.

PLUM VALLEY, WIS.—Articles of incorporation have been filed for the Plum Valley Railway Company, at Pierre, S. D. The company proposes to construct a railway to connect Plum City and Pepin, Wis., a distance of 22 miles. The company is capitalized at $500,000.

HOLDEN, CAN.—The Holden & Vegreville Telephone Company has been incorporated by Norman N. Smith, Charles N. Bresbin, M. Allan, W. Campbell and A. T. Stewart.

Legal.

METER LITIGATION.—The United States Circuit Court of Appeals at Boston has affirmed the decree of the Circuit Court dismissing the bill of the Thomson-Houston Electric Company vs. Isaac McLean, seeking an injunction to restrain the defendant from alleged infringement of a patent, numbered 448,894, relating to improvements in electric meters. The defence set up that the invention had been patented previously in Great Britain, which patent expired July 8, 1904, and by force of the statutes in the United States it expired in this country at the same time. The complainant alleged certain changes in the invention, but the Court holds that no mere changes in detail which do not affect the essence of the invention as covered by the respective patents can avail the complainant.

BLOCKING TELEPHONE MERGER.—Attorney-General Jackson, of New York, has served upon defendants summons and complaint in the action brought by the State against the American Telephone & Telegraph Company, New Jersey Title Guarantee & Trust Company, Security Trust Company of Rochester, George Eastman, Hiram W. Sibley, J. S. Watson, Walter S. Duffey and Edward Bausch. The action grew out of an agreement for the acquisition by the American Telephone & Telegraph Company, generally known as the Bell Company, of the United States Independent Telephone Company and its subsidiary companies in Rochester, Syracuse, Rome, Herkimer and intermediate towns and cities. Incidental to bringing action the Attorney-General obtained from the Supreme Court before Justice Betts an injunction order to be continued pending the action and the substance of which the Attorney-General seeks to make permanent.

GENERAL ELECTRIC REBATES.—At Syracuse, N. Y., on April 11, the jury in the United States Court in the case of the Government against the New York Central Railroad, charged with giving rebates to the General Electric Company at Schenectady, reported that it could not agree and was discharged. In the morning, after having been out 19 hours, the jury asked Judge George W. Ray whether the Central might not legally pay the General Electric if it received help from it in handling freight. The judge in a half hour talk said that unless there was evidence of an agreement to pay it should not be considered. He said that the work performed by the General Electric was for its own benefit. The General Electric Company, it appears, has its own tracks and locomotives and is under no obligations to do free switching for the New York Central Railroad.

TELEPHONE COMPANY'S LIABILITY FOR DAMAGE TO HOUSE BY LIGHTNING CONDUCTED OVER TELEPHONE WIRES.—An action was brought against the Eastern Kentucky Telephone & Telegraph Company in the Circuit Court of Lee County, Kentucky, by one of the company's subscribers to recover for damages to his house which were caused by lightning conducted to the building by means of the company's wires. Prior to the time of the loss the subscriber had notified the company that he wished the telephone box and wires removed from his house. The company complied only to the extent of removing the telephone box, leaving the wires still in the house. Thereafter, during a heavy thunderstorm, lightning struck a tree near the house, to which the telephone wires were attached, and passed along the wires to the dwelling, causing the damage complained of. Though the subscriber knew that the wires were not removed he did not understand that there was any danger connected with their remaining attached to the house, this being his first experience with a telephone. The Circuit Court found for the defendant, but the judgment was reversed upon appeal, the higher court holding that the question of the defendant's negligence should have been left to the jury. It was insisted as a defense that the loss was due to an act of God for which the defendant could not be held responsible, but it was held that, while lightning is an act of God, the carrying of the lightning to the plaintiff's house on the defendant's wires was the act of the defendant and that it was for the jury to determine whether the defendant had used such care as might reasonably be expected of a person of ordinary prudence under the circumstances. In 27 A. & Eng. Encyc. of Law, 1017, the rule is thus stated: "In placing wires for conducting electricity into a house, a telephone company owes the persons living there the exercise of reasonable care, proportioned to the known dangers of the conditions, to prevent the wires acting as conductors of lightning into the building, and it is liable for damage resulting from neglect to provide against this danger. Espcially is it liable where damage from lightning occurs through its failure to remove its wires when the person living in the house has ceased to subscribe for a telephone." Evans vs. Eastern Kentucky Telephone & Telegraph Company, Court of Appeals of Kentucky, 99 S. W. Rep. 936.

CONSTRUCTION OF GRANT OF RIGHT TO ERECT AND MAINTAIN TELEGRAPH LINE.—An interesting controversy has recently been decided in New Jersey involving the right of an assignor of a right of way for a telephone line to set up and operate such a line and the question of the increase of the burden of the easement. The defendant, in 1891, granted to the East Jersey Water Company and its successors, a right of way across certain of his lands, "In and upon which to lay, operate and maintain a water pipe line or water pipes for the transportation of water to the city of Newark * * * with the right to set up, operate and maintain a telegraph or telephone line or lines thereon." The right of way as to the telephone line was successively assigned until it became the property of the Northeastern Telephone & Telepraph Company, the plaintiff in this action. Shortly after the last assignment the plaintiff company entered upon the right of way and replaced the telephone poles which had already been erected with larger poles, placed upon them larger arms, and prepared to increase the number of wires, but did not increase the number of poles. Subsequently the number of wires was increased, and as soon as the increase was accomplished the defendant entered and cut down all the wires. The object of the action was to protect the plaintiff in the enjoyment of the easement and to obtain an injunction restraining the defendant from further interference. It was objected by the defendant at the outset that the East Jersey Water Company had no power to take and accept a grant of a right to maintain a telephone or telegraph system and that, therefore, the grant was invalid. But the answer to this was that it does not lie in the mouth of the grantor of an interest in real estate to set up that the grantee was incapable of receiving the title or right conveyed. Upon the question of the increase of the burden of the easement the court held that the adding of more wires, or even of additional cross-arms, does not perceptibly increase the burden of the easement and that the grant of a right to maintain a telephone line confers the privilege of erecting a single line of poles and placing thereon any number of cross-arms and wires. The defendant then contended that the use of the word "with" in the deed to the East Jersey Water Company, connecting the grant of the right to lay the pipe line with that of the telephone line right of way restricted the latter right so that the telephone line could be used rightfully only in connection with the business of the pipe line. But the court reached the conclusion that "with" was a mere conjunctive, having the force of the word "also" or "and" and that the right to operate a telephone line was not confined or restricted to the purposes of the pipe line business. It was held that the plaintiff was entitled to maintain a telephone and telegraph line for all purposes and the injunction asked for was granted. Northeastern Telephone & Telegraph Company vs. Hepburn, Court of Chancery of New Jersey, 65 Atl. Rep. 747.

SERIES-PARALLEL CONTROLLERS.—In the United States Circuit Court for the District of New Jersey, a preliminary injunction was granted in a suit brought by the General Electric Company to restrain the Sunday Creek Company from the further use of series-parallel controllers manufactured by the Morgan-Gardner Electric Company, of Chicago, Ill., it having been held in a prior suit against another user, the Garrett Coal Company, that such controllers infringed the Knight & Potter patents Nos. 587,441 and 587,442 issued Aug. 3, 1897. Judge Cross grants the injunction against the Sunday Creek Company, giving that company, however, 75 days from the date of the opinion in which to change its controllers or adjust its business so as not to further infringe these patents. These patents cover what is generally known as the "K" type of controller or the type in which the motors are changed from series to parallel connection by the shunting of one motor as opposed to the method in which the circuit is opened while the change from series to multiple connection is made. The Sunday Creek Company is a large coal-mining concern, operating in Ohio and West Virginia, but is incorporated under the laws of New Jersey. The controllers involved in this case were used on mining locomotives. Under the patent agreement existing between the two companies, only the General Electric and Westinghouse Companies can manufacture these controllers.

Personal.

MR. EDWARD J. NALLY, general superintendent of the Postal Telegraph-Cable Company at Chicago, has been elected to fill the position of vice-president and general manager of the same company, succeeding Mr. W. H. Baker, resigned.

MR. CLARENCE E. DELAFIELD has resigned his position as district manager of the Wagner Electric Manufacturing Company, at St. Louis, to accept a position as manager of the high-tension insulator division of the Ohio Brass Company, at Mansfield, O.

MR. FRANK WARREN, secretary of the Warren Electrical Manufacturing Company, Sandusky, O., was a visitor at the Chicago office of the Electrical World recently. Mr. Warren is preparing for a very active campaign for his company, now that the receivership troubles have been settled.

SIR W. H. PREECE, K. C. B., F. R. S., was given the degree of doctor of laws at the dedication of the Carnegie Institute last week by the Western University of Pennsylvania. Dr. McCormick, the chancellor of the university, conferred this and other degrees upon several of the distinguished visitors from Europe.

MR. WILLIAM McCLELLAN, who has for a number of years been connected with Westinghouse, Church, Kerr & Company, and had charge recently of a portion of the work in connection with the electrification of the Erie Railroad at Rochester, has severed his connection with abovenamed company to become a member of the Allison, Campion, McClellan Company, with offices in New York and Philadelphia. The latter company will engage in consulting and constructing engineering work.

MR. W. T. THOMAS, who for a number of years has been associated with the H. C. Roberts Electric Supply Company, of Philadelphia, as general manager, has severed his connection with that company to accept a position as vice-president and manager of the Rumsey Electrical Manufacturers' Company, 1211 Filbert Street, Philadelphia. The Rumsey Electrical Manufacturers' Company, in addition to being manufacturers' agents, have a regular electric supply house, and represent in the Philadelphia territory the Pittsburg Transformer Company, Warren Electrical Manufacturing Company, Geo. Cutter Company, Fostoria Incandescent Lamp Company and the Diamond Meter Company.

MR. S. P. HUNT.—Mr. Samuel P. Hunt, son of Judge Nathan P. Hunt, of Manchester, N. H., has assumed the duties of assistant general manager of the Manchester Traction, Light & Power Company, to which position he has just been chosen. Mr. Hunt will be assistant to General Manager J. Brodie Smith, whose duties have multiplied the past few years, owing to the extension of the Manchester street railway lines and the acquisition of the new line to Nashua. Mr. Hunt is a native of Manchester and is a graduate of the high school. He entered Dartmouth College after his graduation from the high school and completed his course there with honors. Determined to become an expert in the new and extensive field of electrical engineering Mr. Hunt attended the Massachusetts Institute of Technology and took the courses there in the electrical and chemical engineering departments. Mr. Hunt has materially added to his knowledge and experience since graduating from the Institute of Technology. He was employed in the electrical engineering department of the American Telephone and Telegraph Company for some years and later filled a position with the Binghamton, N. Y., Light, Heat & Power Company. Recently he has been with the Boston & Northern street railway with headquarters in Boston.

MR. T. P. SHONTS.—Mr. Theodore P. Shonts, the recently elected president of the Interborough-Metropolitan Company, has now taken absolute charge of all construction and operation work in the company. When Mr. Shonts came to this city to accept the presidency of the traction company, it was understood that he would have direct charge of those branches of the company's business, while Mr. August Belmont was to remain in charge of the financial matters, with the title of chair-

man of the board of directors. It was found, however, that the Interborough-Metropolitan Company, being simply a holding company for many smaller concerns, Mr. Shonts, in his capacity of president, had no legal right to issue orders to the officers of any of the underlying companies, and consequently his powers were very much limited. The difficulty has been overcome by the creation in all the underlying companies of executive committees where none existed before, and by the election of Mr. Shonts as chairman of these committees in all underlying companies. This places Mr. Shonts in control of all the operating and construction work, and it is expected that he will direct the bidding on the new subways as well as institute important changes in the operating of the company's various lines.

MR. W. H. BAKER has resigned the position of vice-president and general manager of the Postal Telegraph-Cable Company. He had been in the company's service for 20 years.

MR. J. H. DOHNER, for a number of years with the National Cash Register Company, has accepted a position as assistant general superintendent with the National-Acme Manufacturing Company, Cleveland, O.

MR. OWEN FORD.—The city of Fort Wayne, Ind., will build a municipal electric light and power plant, for lighting the streets and public buildings at a cost of about $160,000. The power plant will be designed for operating two 500-kw turbine units or three 850-kw engine type alternating-current generators. About 420 arc lamps will be erected upon the streets. Plans and specifications will be completed about May 4. Mr. William J. Hosey is mayor. The Board of Public Works will receive bids and award contracts about June 12. Letting will be duly advertised. Mr. Owen Ford, Security Building, St. Louis, is consulting and supervising engineer.

Trade Publications.

THE TRILL INDICATOR COMPANY, of Corry, Pa., is distributing a book about its indicators, reducing wheels and planimeters, which contains much useful and handy information about taking and reading indicator cards. It shows in detail how to tap the cylinder, make pipe connections, place the indicator, connect it with the crosshead, adjust the tension, etc. The indicator diagram for a single cylinder engine is carefully analyzed and rules given for finding the horse-power. Characteristic diagrams from engines of various types, including faulty diagrams, are analyzed and suggestions made for their correction. This book should be in the hands of every steam engineer.

Business Notes.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., has opened an office at 1113 Schofield Building, Cleveland, Ohio, with O. P. Smith as district manager.

COLUMBIA LAMPS.—The Columbia Incandescent Lamp Company, of St. Louis, Mo., has opened a branch office at room 705, Penn Building, Pittsburg, Pa., in charge of Mr. J. D. O'Bryan, on account of the importance of the lamp trade in Western Pennsylvania and Eastern Ohio, and also because of its own increasing trade in that territory. A complete and well assorted stock will be carried for the prompt supply of customers.

MUDGE & NEEFUS, 20 Broad Street, New York City, electrical engineers and experts, have taken up the subject of electric telpherage, i. e., the transportation by electricity of raw or finished production, by overhead wire or track, in a factory, across country, etc.

THE SARCO COMPANY, 906 Sixth Avenue, New York City, takes pleasure in notifying the trade that Mr. Syles R. Fralick, 269 South Canal Street, Chicago, Ill., is now the Chicago representative of the company and carries a full stock of Sarco swivel separable attachment plugs, pendant switches, key arm and canopy switches and Sarco outlet boxes. There are probably few men better known to the Western trade than Mr. Fralick, as his long connection with the Benjamin Electric Company has secured him many friends in the West, where he has been located for a number of years.

THE JAMESTOWN EXPOSITION.—No section of the country is more rapidly developing its water powers than the Southern States. In all directions a network of electrical lines are stretching out supplied by the generating plants located in the mountains and supplying power to to the cotton mills and kindred industries, doing away with the necessity of fuel and its transportation. The Allis-Chalmers Company, of Milwaukee, Wis., through its hydraulic turbine department, and through its electrical works, has furnished much of the machinery for this development, and now, realizing the importance of the Jamestown Exposition, will bring to the attention of the users of electrical power their motors and transformers, of which a comprehensive display will be made.

THE PITTSBURG GAUGE & SUPPLY COMPANY, Pittsburg, has recently installed White Star oiling systems in the engine rooms of the following concerns: Cincinnati Water Works, Cincinnati, Ohio; Standard Underground Cable Company, Perth Amboy, N. J.; Warner & Swasey Company, Cleveland, Ohio; Baldwin Steel Company, Charleston, W. Va.; New River & P. Coal Company, Berwind, W. Va.; Berwind-White Coal Mining Company, Windber, Pa.; John Wanamaker, New York, N. Y.; Pittsfield Electric Street Railway Company, Pittsfield, Mass.; John Roebling Sons Co., Kinkara, N. J.; Bryan-Marsh Electric Company, Central Falls, R. I.; Louisville Lighting Company, Louisville, Ky. This modern method of lubricating engine bearings is fully illustrated and described in a new catalogue published by the company.

HOLOPHANE GLASS.—As is now well recognized, the correct design of illumination for any given area is based on fundamental mathematical laws. The correct application of these laws, however, requires long experience, careful calculations, good judgment and a fine sense of the artistic. As an example of what it is possible to do by careful design, may be mentioned one large public building recently completed. It was originally designed for the equivalent of 20,000 16-cp lamps. Although the outlets were not placed so as to get the maximum results, by careful study of conditions, correct design of fixtures for illuminating as well as artistic effect, and the selection of the right glassware for each place, the load has been reduced to the equivalent of 15,000 8-cp lamps resulting in a saving of over $25,000 annually. By the selection of scientifically constructed glassware, it is possible to obtain proper diffusion and at the same time direct the maximum amount of light in the desired direction. This is one of the strongest features of the well-known Holophane system of illumination, whose expert staff is freely available for all who have to deal with problems of this character.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED April 9, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

849,368. ELECTRICALLY HEATED HOT-WATER BOTTLE; Herbert W. Christian, Toledo, Ohio. App. filed Jan. 8, 1907. A rubber hot-water bag; has a central tubular chamber which can be removably screwed therein through the neck, and in which is contained an incandescent lamp.

849,375. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed May 11, 1901. In combination with a line-circuit, a cutoff relay, a line relay and a source of current all in said line, in combination with an operator's connective circuit, and means for operating the cutoff relay when operator's circuit is connected with the line.

849,385. ORE-SEPARATOR; John William Gibson, Milwaukee, Wis. App. filed April 2, 1906. An ore separator having a flat table mounted on vertical swinging arms so as to have a reciprocating movement over a series of stationary pole pieces with specially shaped extension pole plates.

849,395. CONDUIT-BOX; Charles A. Hinsdill, Troy, N. Y. App. filed April 20, 1906. Form of conduit box adapted to quickly disclose the wires for inspection. Has a U shaped body and a cover plate both with overlapping end walls which fit together around a conduit pipe.

849,415. PLUG FOR SEALING UNDERGROUND CONDUITS; William L. McGowan, Philadelphia, Pa. App. filed April 28, 1906. A sheet metal plug having resilient blades or springs which enter the conduit pipe to hold a cover plate thereon. The cover plate is perforated or embossed to grip the sealing material.

849,443. CIRCUIT-CHANGING MECHANISM; Harry G. Webster, Chicago, Ill. App. filed Jan. 3, 1905. A circuit closing device of the telephone relay type having a magnet with laterally extending poles and an armature pivoted to lie parallel to the axis of the magnet. This armature directly connects with the spring blades.

849,456. INDICATOR; George Brown, Sarnia, Ont., Can. App. filed April 2, 1906. The throttle of an engine has a mechanical connection with a segment which moves over contact brushes. These are in circuit with lamps in the pilot house so as to indicate the position of such throttle.

849,457. TROLLEY-CONTROLLER.; Willis C. Burdon, Louisville, Ky App. filed Jan. 27, 1906. A toothed bar is fixed vertically at the rear of the car and a heavy block vertically slidable thereon engages the teeth thereof when abruptly moved upward. Has connection with trolley pole to lock the same in case it leaves the wire.

849,464. TELEPHONE TRUNKING SYSTEM; William W. Dean, Chicago, Ill. App. filed July 24, 1902. Relates to complete diagram of circuits of a trunking exchange system.

849,484. PRINTING-TELEGRAPH; Charles J. Menasco, Birmingham, Ala. App. filed March 5, 1906. Complete construction of a key wheel electric typewriter having a rotating arm moving synchronously with that of a master typewriter under the influence of an intermittent current through the telegraph circuit. The printing, release, etc., are done by local circuits completed automatically whenever the moving arms come to rest.

849,503. TROLLEY-POLE; Quinto Saudelli, Fall River, Mass. App. filed Jan. 23, 1906. A trolley wheel support of the toggle lever or lazy tongs type, having parallel motion links which give the wheel an absolutely vertical spring impelled movement above the center of the car.

849,511. BRUSH FOR DYNAMO ELECTRIC MACHINERY; Charles W. Speirs, London, Eng. App. filed Nov. 26, 1906. Carbon brush having an eyelet partly embedded therein and a conductor embedded in the brush and having a portion projecting through said eyelet.

849,582. REGULATION OF ELECTRIC MOTORS; Rowland Stebbins, New York, N. Y. App. filed Nov. 9, 1906. A form of regulator for shunt motors comprising a small dynamo driven by the motor and having a connection with a centrifugal device for varying its load, which includes the field winding of the motor.

849,593. ELECTRIC IGNITER; Wm. Henry Blood, Jr., Wellesley, Mass. App. filed Feb. 2, 1906. The metallic part of a steel file or similar rough iron device is connected in a simple circuit with dry batteries. The file is able to bite or cut a good electric contact for itself when used with a gas range, and the nature of iron and steel causes brilliant sparks even with a low potential current source.

849,606. INSULATOR; Albion Goldstein, St. Louis, Mo. App. filed Feb. 5, 1906. A porcelain block has an integral threaded stud with a V-slot therein to receive the wire, which is thereafter clamped by an internally threaded cap also of porcelain.

849,612. WIRE-COUPLING; Wilhelm Hofman, Kotzchenbroda, Germany. App. filed June 1, 1903. A piece of sheet metal is bent to receive two wire conductors which are then bent in a sinuous form within the clamp by the insertion of conical pins or staples.

849,615. TELEPHONE SWITCH-BOX; Stephen C. Houghton, Rome, N. Y. App. filed Jan. 21, 1907. Form of jack adapted to receive a plug having ring, sleeve and tip contacts.

849,637. AUTOMATIC CUT-OFF; John D. Patton, Rosedale, Kan. App. filed Dec. 8, 1905. A circuit controller adapted to be set to operate at a certain time. Comprises sand glass which tilts after the sand has flowed therethrough.

849,643. COMPOSITION OR COMPOUND FOR BRUSHES OF DYNAMO ELECTRIC MACHINES; Charles W. Spiers, London, England. App. filed June 25, 1905. Compound of plumbago with stratified layers of metallic particles.

849,644. SELF-REGULATING SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Lancaster, N. Y. App. filed April 28, 1905. Generator and system for electric car lighting where the generator is driven by the car axles in varying speeds and directions. Has storage batteries for equalization the potential.

849,651. ALARM FOR FIRE-ESCAPES; Snowden Ashford, Washington, D. C. App. filed May 9, 1906. An attachment for fire escapes by which an alarm circuit is closed in case any extra weight is placed on any of the fire escapes of a flat house. Constitutes a burglar alarm.

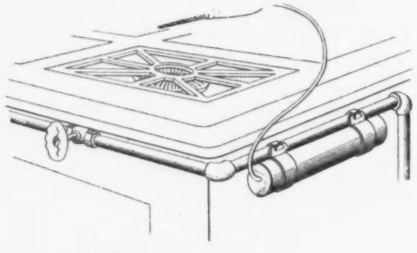
849,653. ELECTROMAGNETIC APPARATUS. Emile Bachelet, Tacoma, Wash. App. filed Aug. 10, 1904. Magnetic coils are positioned at the head and foot of a bed so as to cause a magnetic flux to traverse the patient therein.

849,670. DYNAMO-ELECTRIC MACHINE; Samuel S. Forster, Schenectady, N. Y. App. filed Nov. 29, 1904. A horizontally disposed generator of the type adapted to be driven by Curtis Steam Turbines. Relates particularly to a support for the ends of the armature conductors.

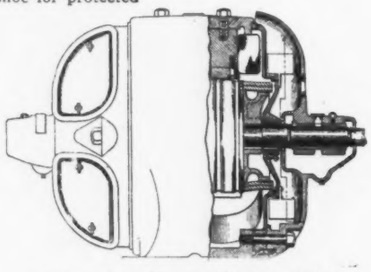
849,684. ELECTRIC SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed May 1, 1901. Has two cut-outs of different current carrying capacity. Has means for compelling the cut-out of lesser capacity being cut in later than the other.

849,698. ELECTRICAL INDICATING APPARATUS; Albert A. Radtke, Chicago, Ill. App. filed Oct. 23, 1905. A simple means for indicating the movements of an end cell switch at a distant point. A form of three magnet motor has a reduction gear connection with a pointer, and is operated by form of 3-phase current established by contacts of the end and cell switch.

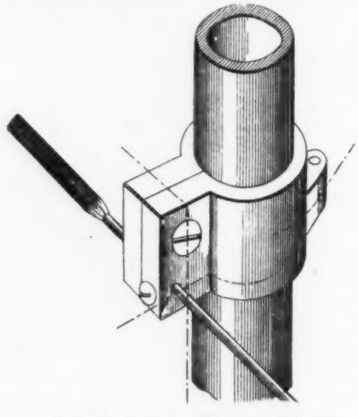
849,703. ELECTRIC RAILWAY; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed April 29, 1901. Form of contact shoe for protected third rails of the type having a waterproof housing thereover. Relates to the spring support of the shoe.



849,593—Electric Igniter.



849,706—Cooling Dynamo-Electric Machines.



849,939—Ground Wire Attachment.

849,705. SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION; Wm. A. Turbayne, Lancaster, N. Y. App. filed Sept. 15, 1904. Control system for dynamos driven by the car axles of a train and adapted to maintain a lighting system at uniform potential notwithstanding changes in speed and direction of the dynamo.

849,706. COOLING DYNAMO-ELECTRIC MACHINES; Eddy R. Whitney, Swampscott, and Leonard A. Tirrill, Lynn, Mass. App. filed Oct. 10, 1903. Relates to the construction of the field frames of a motor or dynamo by which a circulation of cooling air is provided through the windings and conductors.

849,713. DYNAMO ELECTRIC MACHINE; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed June 29, 1905. Has a slotted core and main armature winding carried in the slots thereof and held by wedges. The wedges also have slots with additional windings therein.

849,731. INSULATOR; Siegmund Feuerstein, Rochester, N. Y. App. filed Aug. 24, 1906. A specially formed casting has opposed hooks to engage a conductor and is placed on a knob on the insulator for high potential transmission systems.

849,749. CONTROLLER FOR ELECTRICALLY-PROPELLED VEHICLES; John Smith Raworth, Streatham, England. App. filed Jan. 25, 1906. Designed to make changes from motors in series to motors in parallel and vice versa, and answer the standard conditions imposed in dealing with the heavy currents of this class of apparatus.

849,753. SPEED-LIMITING DEVICE; Fred L. Stone, Schenectady, N. Y. App. filed Sept. 21, 1903. Speed regulating device of the type operating through the making or breaking of an electric circuit to actuate power regulating or controlling mechanism. Relates to mechanical features by which the action is not impaired by grease, oil, dirt, etc.

849,762. AUTOMATIC PRESSURE-CONTROLLED ELECTRIC SWITCH AND AIR-GAGE; Louis H. Westphal, Davenport, Ia. App. filed April 24, 1906. A pressure actuated device particularly adapted for the air compressor system for electric trains. Has a diaphragm connected to a lever which moves to open and close an operating circuit for the main switch.

849,767. TEMPERATURE-REGULATOR; Bert Barton, Dryden, Mich. App. filed May 18, 1906. Themostat has electric connections with a magnet operated valve which controls the air pressure to a diaphragm device for the damper doors of a furnace.

849,773. THIRD-RAIL PROTECTING MECHANISM FOR ELECTRIC RAILWAY; Hamlet Corrigan, Pittston, Pa. App. filed May 3, 1906. The third rail is completely surrounded by form of trough or conduit, the cover of which is slidably displaced during the passage of the train so as to expose the rail.

849,850. TELEPHONE SYSTEM; Leopold F. Muller, Passaic, N. J. App. filed Aug. 7, 1905. An intercommunication telephone system having switches at all the stations by which the circuits are selected.

849,871. TROLLEY; Richard W. Walker, Topeka, Kan. App. filed Oct. 15, 1906. The trolley harp has a pair of inwardly impelled spring fingers which close over the wire in use, but which can be displaced to form guides when the wheel is being positioned on the wire.

849,896. INSULATOR; Charles Griffith, Elizabeth, Pa. App. filed March 24, 1906. A porcelain block is laterally recessed to receive the circuit wire and has a cam wedge to bind against and clamp the wire therein.

849,919. TRANSMISSION OF SIGNALS; Alfred Perrin, Grenoble, France. App. filed May 23, 1904. Has pendulums which are set to oscillate sychronously with pendulums at the master station. Any selected pendulum can be caused to resonate over the single line wire connection by vibrating the proper pendulum at the master station.

849,934. ELECTRICAL ROSETTE; George B. Thomas, Bridgeport, Conn. App. filed Dec. 13, 1905. A rosette formed of a single piece of porcelain and which is formed to guide the line wires downwardly to the suspended lamp or appliance.

849,939. GROUND-WIRE ATTACHMENT; Clarendon L. Tichenor and Charles D. Stoneburner, Washington, D. C. App. filed March 19, 1906. A fixture for connecting a wire to a metal pipe comprising jaws hinged together at one end and having aligned apertures in the opposite end or portions for the reception of the wire, and means connecting the said end portions of the jaw.

849,964. NAUTICAL SIGNAL; Frederick C. Berwick, New York. App. filed March 11, 1905. Has a whistle and a searchlight and a single lever for setting both in operation simultaneously.

849,981. ELECTRICAL HAIR-CURLER; Hans Deierl, Munich, Germany. App. filed Jan. 16, 1907. A resistance element is spirally embedded in an insulating tube to which the circuit wires are connected at opposite ends.

849,994. ACUTE-ANGLE CROSSING FOR ELECTRIC RAILWAYS; Edward E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1906. Comprises a body and end runners pivotally attached thereto and adapted to hold the trolley wire from the body.

850,020. TROLLEY-WIRE HOLDER; Valcoure J. La Bauve, Houston, Tex. App. filed May 9, 1906. A piece of strap iron is bent into a form adapted to be attached to an ordinary trolley harp and produce upwardly extending arms to close over the wire. Is so shaped that the arms can be separated by pulling on a specially connected and arranged cord.

850,064. APPARATUS FOR MEASURING ELECTRIC CAPACITY; Harry Shoemaker, Jersey City, N. J. App. filed Oct. 9, 1906. Has a Wheatstone bridge with a known capacity in one arm thereof, an unknown capacity connected with the other arm thereof, and means for automatically charging and discharging said capacities.

850,065. HIGH-POTENTIAL MEASURING INSTRUMENT; Harry Shoemaker, Jersey City, N. J. App. filed Oct. 29, 1906. Has a sealed glass tube with a movable liquid seal which is displaced by the rise of temperature of the gas in the tube under the influence of an electric discharge therein.

850,079. TELEPHONE REPEATER SYSTEM; Nathaniel G. E. Warth, Columbus, Ohio. App. filed Feb. 5, 1907. Has means inductively associating the main line circuit with a uni-directional repeater apparatus to prevent self induction in the same.

850,081. AUTOMATIC PRESSURE-CONTROLLED ELECTRIC SWITCH AND AIR-GAUGE; Louis H. Westphal, Davenport, Ia. App. filed Oct. 3, 1905. Pressure gauge device of the type adapted to control the motors of an air compressor system. Has a spring impelled diaphragm plunger with lever connections to a circuit controling blade or lever.

850,100. MINING SIGNAL SYSTEM; Norman S. Richmond, Oshkosh, Wis. App. filed April 9, 1906. A signal system for use in mines whereby signals may be sent from any level to the engineer. Provides means by which an indication at each level is made that a signal is being sent whereby avoiding interference signals if more than one is sent at the same time.

850,101. DROP FOR ELECTRIC CIRCUITS; William H. Robins, Minneapolis, Minn. App. filed Dec. 6, 1905. Relates to signalling drops used with burglar alarm circuits and aims to provide means by which the drop will operate with certainty to close the alarm circuit in case of the closure of a local circuit.

850,116. CORE-SEPARATOR; John P. Mallett, Madison, Wis. App. filed Aug. 1, 1905. Relates to an arrangement of the spacers or separators used for forming ventilating ducts in electrical apparatus. Particularly adapted for use with laminated magnetic cores for the purpose of forming ventilating ducts by separating the sections of the magnetic cores.

850,117. ELECTRIC RAILWAY; William B. Potter, Schenectady, N. Y. App. filed Sept. 24, 1902. Relates to electric railways of the type having normally de-energized sections which are connected with the feeder successively as the car proceeds. Provides means by which the switches are actuated by a local battery circuit on the car which is also used for the auxiliary motors, the lighting and the heating.